

A.2.7 CALIFORNIA COASTAL CHINOOK SALMON

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A.2.7.1 Summary of Previous BRT Conclusions

The status of chinook salmon throughout California and the Pacific Northwest was formally assessed in 1998 (Myers et al. 1998). Substantial scientific disagreement about the biological data and its interpretation persisted for some Evolutionarily Significant Units (ESUs); these ESUs were reconsidered in a subsequent status review update (NMFS 1999). Information from those reviews regarding ESU structure, analysis of extinction risk, risk factors, and hatchery influences is summarized in the following sections.

ESU structure

The initial status review proposed a single ESU of chinook salmon inhabiting coastal basins south of Cape Blanco and the tributaries to the Klamath River downstream of its confluence with the Trinity River (Myers et al. 1998). Subsequent review of an augmented genetic data set and further consideration of ecological and environmental information led to the division of the originally proposed ESU into the Southern Oregon and Northern California Coastal Chinook Salmon ESU and the California Coastal Chinook Salmon ESU (NMFS 1999). The California Coastal Chinook Salmon ESU currently includes chinook salmon from Redwood Creek to the Russian River (inclusive).

Summary of risk factors and status

The California Coastal Chinook Salmon ESU is listed as Threatened. Primary causes for concern were low abundance, reduced distribution (particularly in the southern portion of the ESU's range), and generally negative trends in abundance; all of these concerns were especially strong for spring-run chinook salmon in this ESU (Myers et al. 1998). Data for this ESU are sparse and, in general of limited quality, which contributes to substantial uncertainty in estimates of abundance and distribution. Degradation of the genetic integrity of the ESU was considered to be of minor concern and to present less risk for this ESU than for other ESUs.

Previous reviews of conservation status for chinook salmon in this area exist. Nehls et al. (1991) identified three putative populations (Humboldt Bay Tributaries, Mattole River, and Russian River) as being at high risk of extinction and three other populations (Redwood Creek, Mad River, and Lower Eel River) as being at moderate risk of extinction. Higgins et al. (1992) identified seven “stocks of concern,” of which two populations (tributaries to Humboldt Bay and the Mattole River) were considered to be at high risk of extinction. Some reviewers indicate that chinook salmon native to the Russian River have been extirpated.

Historical estimates of escapement are presented in Table A.2.7.1. These estimates are based on professional opinion and evaluation of habitat conditions, and thus do not represent

rigorous estimates based on field sampling. Historical time series of counts of upstream migrating adults are available for Benbow Dam (South Fork Eel River 1938-1975), Sweasy Dam (Mad River 1938-1964), and Cape Horn Dam (Van Arsdale Fish Station, Eel River); the latter represent a small, unknown and presumably variable fraction of the total run to the Eel River. Data from cursory, nonsystematic stream surveys of two tributaries to the Eel River (Tomki and Sprowl Creeks) and one tributary to the Mad River (Canon Creek) were also available; these data provide crude indices of abundance.

Previous status reviews considered the following to pose significant risks to the California Coastal Chinook Salmon ESU: degradation of freshwater habitats due to a variety of agricultural and forestry practices, water diversions, urbanization, mining, and severe recent flood events (exacerbated by land use practices). Special concern was noted regarding the more precipitous declines in distribution and abundance in spring-run chinook salmon. Many of these factors are particularly acute in the southern portion of the ESU range and were compounded by uncertainty stemming from the general lack of population monitoring in California (Myers et al. 1998).

In previous status reviews, the effects of hatcheries and transplants on the genetic integrity of the ESU elicited less concern than other risk factors for this ESU, and were less of a concern for this ESU in comparison to other ESUs.

Listing status

The California Coastal Chinook Salmon ESU is currently listed as “Threatened.”

Table A.2.7.1. Historical estimates of abundance of chinook salmon in the California Coastal Chinook Salmon ESU.

Selected Watersheds	CDFG 1965	Wahle & Pearson 1987
Redwood Creek	5,000	1,000
Mad River	5,000	1,000
Eel River	55,000	17,000
Mainstem Eel ^a	13,000	
Van Duzen Rivera ^a	2,500	
Middle Fork Eel ^a	13,000	
South Fork Eel ^a	27,000	
Bear River		100
Small Humboldt County Rivers	1,500	
Miscellaneous Rivers North of Mattole		600
Mattole River	5,000	1,000
Noyo River	50	
Russian River	500	50
Total	72,550	20,750

^aEntries for subbasins of the Eel River Basin are not included separately in the total.

A.2.7.2 New Data and Updated Analysis

The TRT for the North-Central California Coast Recovery Domain has proposed a set of plausible hypotheses, based largely on geography, regarding the population structure of the California Coast Chinook Salmon ESU (Table A.2.7.2), but has concluded that insufficient information exists to discriminate among these hypotheses (NCCC-TRT, *in preparation*). Data are not available for all of the potential populations; only those for which data are available are considered below.

New or updated time series for chinook salmon in this ESU include 1) counts of adults reaching Van Arsdale Fish Station near the effective headwater terminus of the Eel River; 2) cursory, quasi-systematic spawner surveys on Canon Creek (tributary to the Mad River), Tomki Creek (tributary to the Eel River), and Sprowl Creek (tributary to the Eel River); 3) counts of returning spawners at a weir on Freshwater Creek (tributary to Humboldt Bay). None of these time series is especially suitable for analysis of trends or estimation of population growth rates.

Table A.2.7.2. Plausible hypotheses for independent populations considered by the North Central California Coast TRT. This information is summarized from a working draft report and should be considered as preliminary and subject to revision.

“Lumped”	“Split”
Redwood Creek	
Mad River	
Humboldt Bay Tributaries	
Eel River ^a	
	South Fork Eel River
	Van Duzen River
	Middle Fork Eel River
	North Fork Eel River
	Upper Eel River
Bear River	
Mattole River	
Tenmile to Gualala ^b	
Russian River	

^aPlausible hypotheses regarding the population structure of chinook salmon in the Eel River basin include scenarios ranging from five independent populations (South Fork Eel River, Van Duzen River, Upper Eel River, Middle Fork Eel River, and North Fork Eel River) to a single, strongly structured independent population.

^bThis stretch of the coast comprises numerous smaller basins that drain directly into the Pacific Ocean, some of which appear sufficiently large to support independent populations of chinook salmon. The following hypotheses span much of the range of plausible scenarios: (1) independent populations exist in all basins that exceed a minimum size; (2) independent populations exist only in basins between the Tenmile River and Big River, inclusive, that exceed a minimum size; (3) chinook salmon inhabiting basins along this stretch of coastline exhibit patchy population or metapopulation dynamics in which the occupancy of any given basin is dependent on migrants from other basins, and possibly from larger basins to the north and south; and (4) chinook salmon inhabiting basins between the Tenmile River and Big River, inclusive, exhibit patchy population or metapopulation dynamics in which the occupancy of any given basin is dependent on migrants from other basins in this region and possibly to the north, while other basins to the south only sporadically harbor chinook salmon.

Table A.2.7.3. Geometric means, estimated lambda, and long- and short-term trends for abundance time series in the California Coastal Chinook Salmon ESU.

	5 year Geometric Mean			Trend	
	Rec	Min	Max	Long	Short
Freshwater Creek	22	13	22	0.137 (-0.405, 0.678)	0.137 (-0.405, 0.678)
Mad River					
Canon Creek	73	19	103	0.0102 (-0.106, 0.127)	0.155 (-0.069, 0.379)
Eel River					
Sprowl Creek	43	43	497	-0.096 (-0.157, -0.034)	-0.183 (-0.356, -0.010)
Tomki Creek	61	13	2,233	-0.199 (-0.351, -0.046)	0.294 (0.055, 0.533)

Freshwater Creek—Counts of chinook salmon passing the weir near the mouth of Freshwater Creek, a tributary to Humboldt Bay, provide a proper census of a small ($N \sim 20$) population of naturally and hatchery-spawned chinook salmon (Figure A.2.7.1). Chinook salmon occupying this watershed may be part of a larger “population” that uses tributaries of Humboldt Bay (NCCC-TRT, *in preparation*). The time series comprises only 8 years of observations, which is too few to draw strong inferences regarding trends. Clearly, the trend is positive, although the role of hatchery production in producing this signal may be significant (Table A.2.7.3; Figure A.2.7.1).

Mad River—Data for naturally spawning fish are available from spawner surveys on Canon Creek, and to a lesser extent on the North Fork Mad River. Only the counts from Canon Creek extend continuously to the present (Figure A.2.7.2a). Due to high variability in these counts, short-term and long-term trends do not differ significantly from zero, although the tendency is toward a positive trend. Due to a hypothesized, but unquantified, effect of interannual variation in water availability on distribution of spawners in the basin, it is not clear whether these data provide any useful information for the population as a whole; however, more sporadic counts from the mainstem Mad River suggest that the estimates from Canon Creek capture gross signals, and support the hypothesis of a recent positive trend in abundance (Figure A.2.7.2b).

Eel River—The Eel River plausibly harbors anywhere from one to five independent populations (NCCC-TRT, *in prep.*, Table A.2.7.2). Three current time series provide information for the population(s) that occupy this basin: 1) counts of adults reaching Van Arsdale Fish Station near the effective headwater terminus of the Eel River (Figure A.2.7.3a); 2) spawner surveys on Sprowl Creek (tributary to the Eel River) (Figure A.2.7.3b); and 3) spawner surveys on Tomki Creek (tributary to the Eel River) (Figure A.2.7.3c). These data are not especially suited to rigorous analysis of population status for a number of reasons, and sophisticated analyses were not pursued.

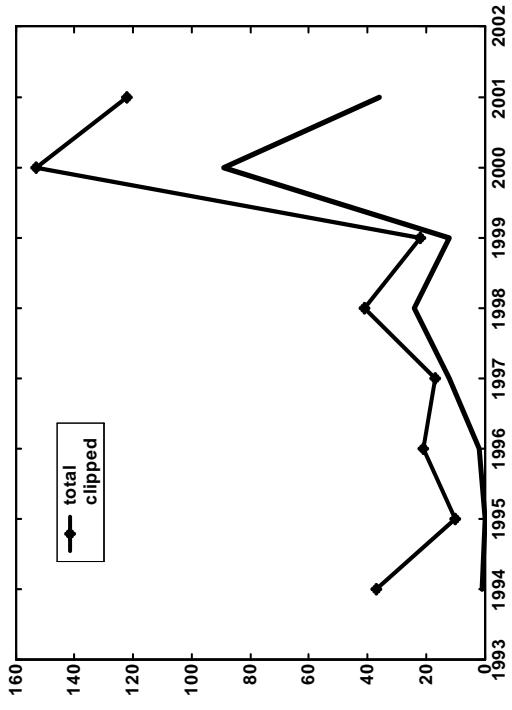


Figure A.2.7.1. Counts of chinook salmon at the weir on Freshwater Creek.

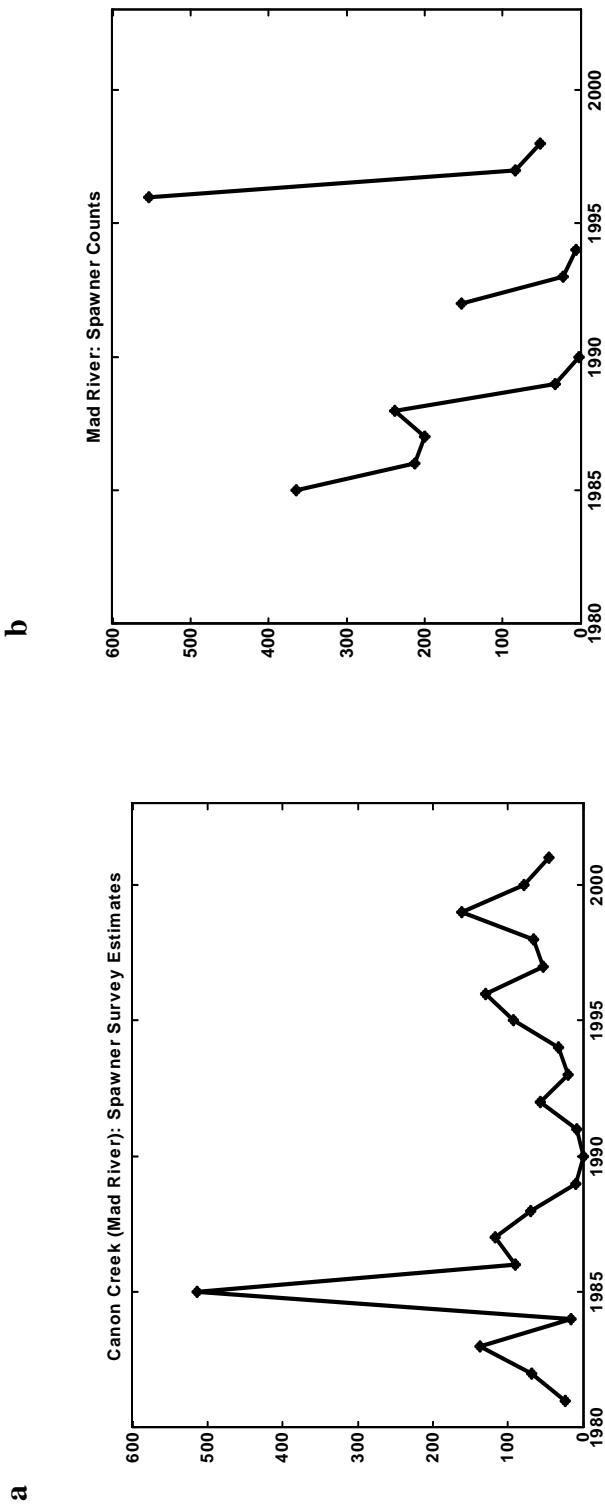


Figure A.2.7.2. Abundance time series for chinook salmon in portions of the Mad River basin. (a) spawner counts on Canon Creek; and (b) spawner counts on portions of the mainstem Mad River.

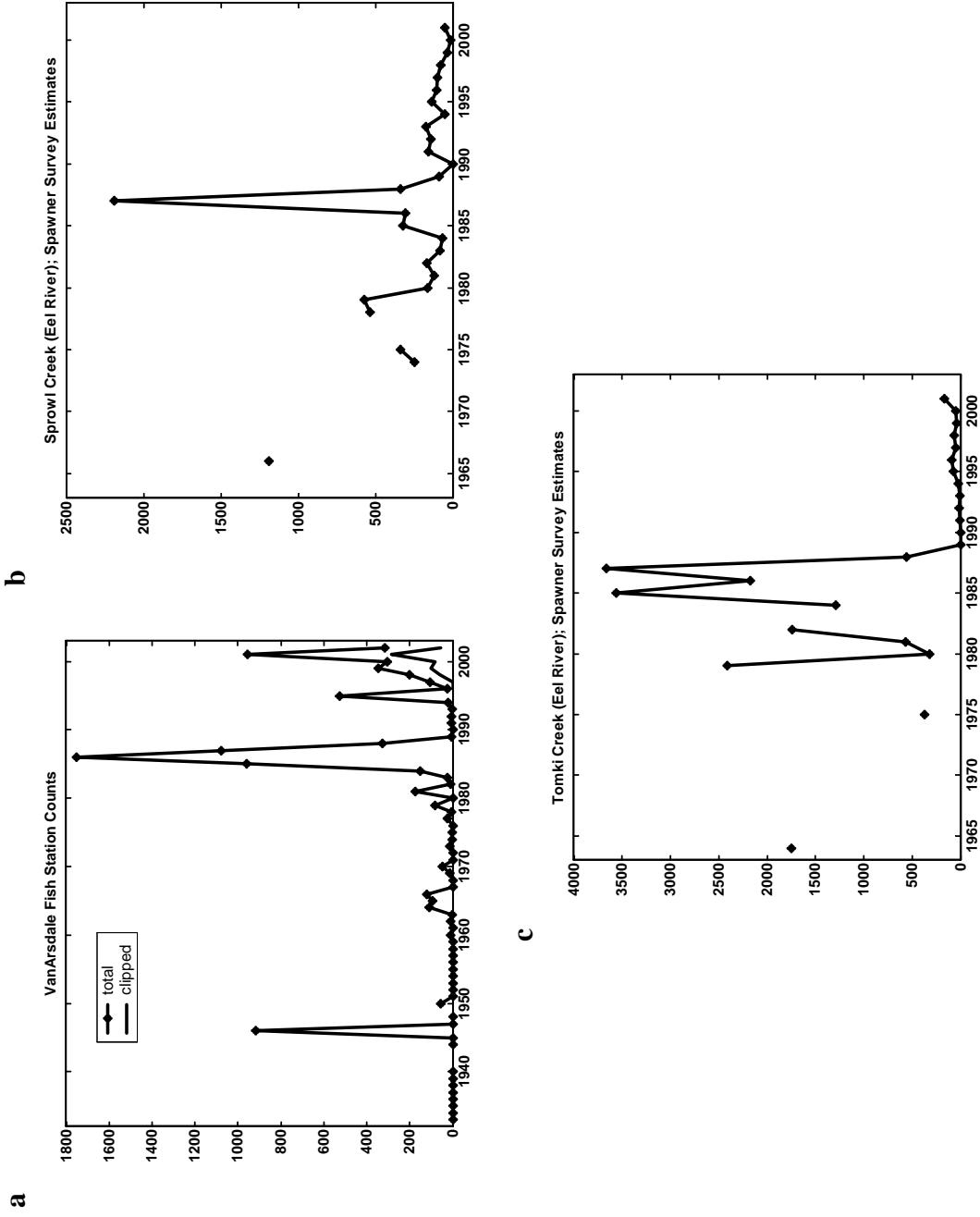


Figure A.2.7.3. Abundance time series for chinook salmon in portions of the Eel River basin. (a) counts of chinook salmon at Van Ardsale Fish Station at the upstream terminus of anadromous access on the mainstem Eel River; (b) estimates of spawner abundance based on spawner surveys and additional data from Sprowl Creek; and (c) estimates of spawner abundance based on spawner surveys and additional data from Tomki Creek.

Inferences regarding population status drawn from the time series of counts of adult chinook salmon reaching Van Arsdale Fish Station (VAFS) are weakened by two characteristics of the data. First, adult salmon reaching VAFS include both naturally and hatchery-spawned fish, yet the long-term contribution of hatchery production to the spawner population is unknown and may be quite variable due to sporadic operation of the egg take-and-release programs since the mid-1970s. Second, and perhaps more importantly, it is not clear what counts of natural spawners at VAFS indicate about the population or populations of chinook salmon in the Eel River. As a weir count, measurement error is expected to be small for these counts. However, very little spawning habitat exists above VAFS, which sits just below the Cape Horn dam on the Eel River, which suggests that counts made at VAFS represent the upper edge of the spawners' distribution in the Upper Eel River. Spawner access to VAFS and other headwater habitats in the Eel River basin is likely to depend strongly on the timing and persistence of suitable river flow, which suggests that a substantial component of the process error in these counts is not due to population dynamics. For these reasons, no statistical analysis of these data was pursued.

Additional data for the Eel River population or populations are available from spawner surveys from Tomki and Sprowl Creeks, which yield estimates of abundance based on 1) quasi-systematic index site spawner surveys that incorporate mark-recapture of carcasses and 2) additional so-called "compatible" data from other surveys. Analysis for Sprowl Creek indicates negative long-term and short-term trends; similar analysis indicates a long-term decline and short-term increase for Tomki Creek (Table A.2.7.3). Caution in interpreting these results is warranted, particularly given the quasi-systematic collection of these data, and the likelihood that these data include unquantified variability due to flow-related changes in spawners' use of mainstem and tributary habitats. In particular, inferences regarding population status based on extrapolations from these data to basin-wide estimates of abundance are expected to be weak and perhaps not warranted.

Mattole River—Recent spawner and redd surveys on the Mattole River and tributaries have been conducted by the Mattole Salmon Group since 1994. The surveys provide useful information on the distribution of salmon and spawning activity throughout the basin. Local experts have used these and ancillary data to develop rough "index" estimates of spawner escapement to the Mattole; however, the intensity and coverage of these surveys has not been consistent, and the resulting data are not suitable for rigorous estimation of abundance (e.g., through area-under-the-curve analysis).

Russian River—No long-term, continuous time series are available for sites in the Russian River Basin, but sporadic estimates based on spawner surveys are available for some tributaries. Video-based counts of upstream migrating adult chinook salmon passing a temporary dam near Mirabel on the Russian River are available for 2000-2002. Counts are incomplete, due to technical difficulties with the video apparatus, occasional periods of poor water clarity, occasional overwhelming numbers of fish, and disparities between counting and migration periods; thus, these data represent a minimum count of adult chinook salmon. Counts have exceeded 1,300 fish in each of the last three years (5,465 in 2002); and a rigorous mark-recapture estimate of outmigrant abundance in 2002 exceeded 200,000 (Shawn Chase, Sonoma County

Water Agency, *personal communication*). Since chinook salmon have not been produced at the Don Clausen Hatchery since 1997, these counts represent natural production or straying from other systems. No data were available to assess the genetic relationship of these fish to others in this or other ESUs.

Summary—Historical and current information indicates that abundance in putatively independent populations of chinook salmon is depressed in many of those basins where they have been monitored. The relevance of recent strong returns to the Russian River to ESU status are not clear as the genetic composition of these fish is unknown. Reduction in geographic distribution, particularly for spring-run chinook salmon and for basins in the southern portion of the range, continues to present substantial risk. Genetic concerns are reviewed below (Hatchery Information). As for previous status reviews, uncertainty continues to contribute substantially to assessments of risk facing this ESU.

A.2.7.3 Hatchery Information

Hatchery stocks that are being considered for inclusion in this ESU are: 1) Mad River Hatchery; 2) hatchery activities of the Humboldt Fish Action Council on Freshwater Creek; 3) Yager Creek Hatchery operated by Pacific Lumber Company; 4) Redwood Creek Hatchery; 5) Hollow Tree Creek Hatchery; 6) Van Arsdale Fish Station; and 6) hatchery activities of the Mattole Salmon Group. Chinook salmon are no longer produced at the Don Clausen hatchery on Warm Springs Creek (Russian River). In general, hatchery programs in this ESU are not oriented toward large-scale production, but rather are small-scale operations oriented at supplementing depressed populations.

Freshwater Creek—This hatchery is operated by Humboldt Fish Action Council and CDFG to supplement and restore natural production in Freshwater Creek. All spawners are from Freshwater Creek; juveniles are marked and hatchery fish are excluded from use as broodstock. Weir counts provide good estimates of the proportion of hatchery- and naturally produced fish returning to Freshwater Creek (30%-70% hatchery from 1997-2001); the contribution of HFAC production to spawning runs in other streams tributary to Humboldt Bay is unknown.

Mad River—Recent production from this hatchery has been based on small numbers of spawners returning to the hatchery. There are no estimates of naturally spawning chinook salmon abundance available for the Mad River to determine the contribution of hatchery production to chinook salmon in the basin as a whole. Broodstock has generally been drawn from chinook salmon returning to the Mad River; however, releases in the 1970s and 1980s have included substantial releases of fish from out-of-basin (Freshwater Creek) and out-of-ESU (Klamath-Trinity and Puget Sound).

Eel River—Four hatcheries, none of which are major production hatcheries, contribute to production of chinook salmon in the Eel River Basin: hatcheries on Yager Creek (recent effort: ~12 females spawned per year), Redwood Creek (~12 females), Hollow Tree Creek, and the Van Arsdale Fish Station (VAFS) (~60 males and females spawned). At the first three hatcheries, broodstock is selected from adults of non-hatchery origin; at VAFS, broodstock includes both natural and hatchery-origin fish. In all cases, however, insufficient data on naturally spawning chinook salmon are available to estimate the effect of hatchery fish on production or other

characteristics of naturally spawning chinook salmon in the Eel River Basin. Since 1996, all fish released from VAFS have been marked. Subsequent returns indicate that approximately 30% of the adult chinook salmon trapped at VAFS are of hatchery origin. It is not clear what these numbers indicate about hatchery contributions to the population of fish spawning below VAFS.

Mattole River—The Mattole Salmon Group has operated a small hatchbox program since 1980 (current effort: ~40,000 eggs from ~10 females) to supplement and restore chinook salmon and other salmonids in the Mattole River. All fish are marked, but no rigorous estimate of hatchery contributions to adult escapement is possible. Hatchery-produced outmigrants comprised approximately 17.3% (weighted average) of outmigrants trapped during 1997, 1998, and 2000 (Mattole Salmon Group 2000, Five Year Management Plan for Salmon Stock Rescue Operations 2000-2001 through 2004-2005 Seasons). Trapping efforts did not fully span the period of natural outmigration, so this figure may overestimate the contribution of hatchbox production to total production in the basin.

Russian River—Production of chinook salmon at the Don Clausen (Warm Springs Hatchery) ceased in 1997 and had been largely ineffective for a number of years prior to that. Recent returns of chinook salmon to the Russian River stem from natural production, and possibly from fish straying from other basins, including perhaps Central Valley stocks.

Summary

Artificial propagation of chinook salmon in this ESU remains at relatively low levels. No putatively independent populations of chinook salmon in this ESU appear to be entirely dominated by hatchery production, although proportions of hatchery fish can be quite high where natural escapement is small and hatchery production appears to be successful (e.g., Freshwater Creek). It is not clear whether current hatcheries pose a risk or offer a benefit to naturally spawning populations. Extant hatchery programs are operated under guidelines designed to minimize genetic risks associated with artificial propagation, and save for historical inputs to the Mad River Hatchery stock, do not appear to be at substantial risk of incorporating out-of-basin or out-of-ESU fish. Thus, it is likely that artificial propagation and degradation of genetic integrity continue to not represent a substantial conservation risk to the ESU. Categorizations of hatchery stocks in the California Coastal chinook salmon ESU (SSHAG 2003) can be found in Appendix A.5.1.

A.2.7.4 Comparison with Previous Data

Few new data, and few new datasets were available for consideration, and none of the recent data contradict the conclusions of previous status reviews. Chinook salmon in the Coastal California ESU continue to exhibit depressed population sizes relative to historical abundances; this is particularly true for spring-run chinook salmon, which may no longer be extant anywhere within the range of the ESU. Evaluation of the significance of recent potential increases in abundance of chinook salmon in the Russian River must weigh the substantial uncertainty regarding the genetic relatedness of these fish to others in the northern part of the ESU.

Harvest rates are not explicitly estimated for this ESU; however, it is likely that current restrictions on harvest of Klamath River fall-run chinook salmon maintain low ocean harvest of

chinook salmon from the California Coastal ESU (PFMC 2002a, b). Potential changes in age-structure of chinook salmon populations (e.g., Hankin et al. 1993) and associated risk has not been evaluated for this ESU.

No information exists to suggest new risk factors, or substantial effective amelioration of risk factors noted in the previous status reviews save for recent changes in ocean conditions. Recent favorable ocean conditions have contributed to apparent increases in abundance and distribution for a number of anadromous salmonids, but the expected persistence of this trend is unclear.

A.2.8 SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON

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A.2.8.1 Summary of Previous BRT Conclusions

The status of chinook salmon coastwide was formally assessed in 1998 (Myers et al. 1998); however, NMFS had previously recognized Sacramento River winter-run chinook as a “distinct population segment” under the ESA (NMFS 1987).

Summary of major risk factors and status indicators

Historically, winter-run chinook salmon were dependent on access to spring-fed tributaries to the upper Sacramento River that stayed cool during the summer and early fall. Adults enter freshwater in early winter and spawn in the spring and summer. Juveniles rear near the spawning location until at least the fall, when water temperatures in lower reaches are suitable for migration. Winter-run chinook salmon were abundant and comprised populations in the McCloud, Pit, and Little Sacramento, with perhaps smaller populations in Battle Creek and the Calaveras River. On the basis of commercial fishery landings in the 1870s, Fisher (1994) estimated that the total run size of winter-run chinook salmon may have been 200,000 fish.

The most obvious challenge to winter-run chinook salmon was the construction of Shasta Dam, which blocked access to the entire historic spawning habitat. It was not expected that winter-run chinook salmon would survive this habitat alteration (Moffett 1949). Cold-water releases from Shasta, however, created conditions suitable for winter-run chinook salmon for roughly 100 km downstream from the dam. Presumably, there were several independent populations of winter-run chinook salmon in the Pitt, McCloud, and Little Sacramento Rivers, and various tributaries to these rivers, such as Hat Creek and the Fall River. These populations merged to form the present single population. If there ever were populations in Battle Creek and the Calaveras River, they have been extirpated.

In addition to having only a single extant population dependent on artificially created conditions, winter-run chinook salmon face numerous other threats. Chief among these is small population size—escapement fell below 200 fish in the 1990s. Population size declined monotonically from highs of near 100,000 fish in the late 1960s, indicating a sustained period of poor survival. There are questions of genetic integrity due to winter-run chinook salmon having passed through several bottlenecks in the 20th century. Other threats include inadequately screened water diversions, predation at artificial structures and by non-native species, pollution from Iron Mountain Mine (among other sources), adverse flow conditions, high summer water temperatures, unsustainable harvest rates, passage problems at various structures (e.g., Red Bluff Diversion Dam), and vulnerability to drought.

Previous BRT conclusions

The chinook salmon BRT spent little time considering the status of winter-run chinook salmon, because winter-run chinook salmon were already listed as endangered at the time of previous BRT meetings.

Listing status

Winter-run chinook salmon were listed as Threatened in 1990 and reclassified as Endangered 1994.

A.2.8.2 New Data and Updated Analyses

Viability assessments

Two studies have been done on the population viability of Sacramento River winter-run chinook salmon. Botsford and Brittnacher (1998), in a paper that is part of the draft recovery plan, developed de-listing criteria using a simple age-structured, density-independent model of spawning escapement. They concluded, on the basis of the 1967-1995 data, that winter-run chinook salmon were certain to fall below the quasi-extinction threshold of three consecutive spawning runs with less than 50 females.

Lindley and Mohr (2003) developed a slightly more complex Bayesian model of winter-run chinook salmon spawning escapement that allowed for density dependence and a change in population growth rate in response to conservation measures initiated in 1989. This model, due to its allowance for the growth rate change, its accounting for parameter uncertainty, and use of newer data (through 1998), suggested a lower but still biologically significant expected quasi-extinction probability of 28%.

Draft recovery plan

The draft recovery plan for winter-run chinook salmon (NMFS 1997) provides a comprehensive review of the status, life history, habitat requirements, and risk factors of winter-run chinook salmon. It also provides a recovery goal: an average of 10,000 females spawners per year and a $\lambda \geq 1.0$ calculated over 13 years of data (assuming a certain level of precision in spawning escapement estimates).

New abundance data

The winter-run chinook salmon spawning run has been counted at Red Bluff Diversion Dam (RBDD) fish ladders since 1967. Escapement has been estimated with a carcass survey since 1996. Through the mid-1980s, the RBDD counts were very reliable. At that time, changes to the dam operation were made to alleviate juvenile and adult passage problems. Now, only the tail end of the run (about 15% on average) is forced over the ladders, greatly reducing the accuracy of the RBDD counts. The carcass mark-recapture surveys were initiated to improve

escapement estimates. The two measures are in very rough agreement, and there are substantial problems with both estimates, making it difficult to choose one as more reliable than the other. One problem with the carcass-based estimate is the estimation of the probability of capturing carcasses—it appears that the probability of initial carcass recovery depends strongly on the sex of the fish, the size of the fish, and possibly on whether it has been previously recovered. In the winter-run chinook salmon carcass surveys, a high ratio of female to males is observed (e.g., Snider et al. 1999), and several studies of salmon carcass recovery have noted that females are recovered with a higher probability than males, presumably because of the different behavior of males and females (e.g., Shardlow et al. 1986 and references therein). In spite of these problems, both abundance measures suggest that the abundance of winter-run chinook salmon is increasing. Based on the RBDD counts, the winter-run chinook salmon population has been growing rapidly since the early 1990s (Figure A.2.8.1), with a short-term trend of 0.26 (Table A.2.8.1). On the population growth rate-population size space, the winter-run chinook salmon population has a somewhat low population growth and moderate size compared to other Central Valley salmonid populations (Figure A.2.8.2).

Table A.2.8.1. Summary statistics for trend analyses. Numbers in parentheses are 0.90 confidence intervals. Results for other populations are shown for comparison.

Population	5-yr mean	5-yr min	5-yr max	λ	μ	LT trend	ST trend
Sacramento River winter-run chinook	2,191	364	65,683	0.97 (0.87, 1.09)	-0.10 (-0.21, 0.01)	-0.14 (-0.19, -0.09)	0.26 (0.04, 0.48)
Butte Creek spring-run chinook	4,513	67	4,513	1.30 (1.09, 1.60)	0.11 (-0.05, 0.28)	0.11 (0.03, 0.19)	0.36 (0.03, 0.70)
Deer Creek spring-run chinook	1,076	243	1,076	1.17 (1.04, 1.35)	0.12 (-0.02, 0.25)	0.11 (0.02, 0.21)	0.16 (-0.01, 0.33)
Mill Creek spring-run chinook	491	203	491	1.19 (1.00, 1.47)	0.09 (-0.07, 0.26)	0.06 (-0.04, 0.16)	0.13 (-0.07, 0.34)
Sacramento River steelhead	1,952	1,425	12,320	0.95 (0.90, 1.02)	-0.07 (-0.13, 0.00)	-0.09 (-0.13, -0.06)	NA

Winter-run chinook salmon may be responding to a number of factors, including wetter-than-normal winters, changes in ocean harvest regulations since 1995 significantly reducing harvest, changes in RBDD operation, improved temperature management on the Upper Sacramento (including installation of a cold-water release device on Shasta Dam), water quality improvements due to remediation of Iron Mountain Mine discharges, changes in operations of the state and federal water projects, and a variety of other habitat improvements. While the status of winter-run chinook salmon is improving, there is only one winter-run chinook salmon population and it is dependent on cold-water releases of Shasta Dam, which could be vulnerable to a prolonged drought. The recent 5-year geometric mean is only 3% of the maximum post-1967 5-year geometric mean.

The RBDD counts are suitable for modeling as a random-walk-with-drift (also known as the “Dennis model” [Dennis et al. 1991]). In the RWW model, population growth is described by exponential growth or decline:

$$N_{t+1} = N_t \exp(\mu + \eta_t), \quad (1)$$

where N_t is the population size at time t , μ is the mean population growth rate, and η_t is a normal random variable with mean=0 and variance = σ_p^2 .

Table A.2.8.2. Parameter estimates for the constant-growth and step-change models applied to winter-run chinook salmon. Numbers in parentheses indicate 90% confidence intervals.

parameter	Model	
	constant μ	step change μ
μ	-0.085 (-0.181, 0.016)	-0.214 (-0.322, -0.113)
δ	NA NA	0.389 (0.210, 0.574)
σ_p^2	0.105 (0.094, 0.122)	0.056 (0.046, 0.091)
σ_m^2	0.0025 (2.45E-6, 0.0126)	0.011 (3.92E-6, 0.022)
$P_{100}(\text{ext})^{[a]}$	0.40 (0.00, 0.99)	0.003 (0.0, 0.0)

[a] Probability of extinction (pop. size < 1 fish) within 100 years.

The RWWD model, as written in Equation 1, ignores measurement error. Observations (y_t) can be modeled separately,

$$y_t = N_t \exp(\varepsilon_t), \quad (2)$$

where ε_t is a normal random variable with mean = 0 and variance = σ_m^2 . Equations 1 and 2 together define a state-space model that, after linearizing by taking logarithms, can be estimated using the Kalman filter (Lindley in press).

A recent analysis of the RBDD data (Lindley and Mohr 2003) indicated that the population growth since 1989 was higher than in the preceding period. For this reason, I fit two forms of the RWWD model—one with a fixed growth rate (constant-growth model) and another with a growth rate with a step-change in 1989, when conservation actions began (step-change model, $\mu_t = \mu$ for $t < 1989$, $\mu_t = \mu + \delta$ for $t \geq 1989$). In both cases, a 4-year running sum was applied to the spawning escapement data to form a total population estimate (Holmes 2001). Results of model fitting are shown in Table A.2.8.2. The constant-growth model satisfies all model diagnostics, although visual inspection of the residuals shows a strong tendency to under-predict abundance in the most recent 10 years. The residuals of the step-change model fail the Shapiro-Wilks test for normality; the residuals look truncated on the positive side, meaning that good years are not as extreme as bad years. Winter-run chinook salmon growth rate might be better modeled as a

mixture between a normal distribution and another distribution reflecting near-catastrophic population declines caused by episodic droughts.

According to Akaike's information criterion (AIC), the step-change model is a much better approximation to the data than the constant population growth rate model, with an AIC difference of 9.61 between the two models (indicating that the data provide almost no support for the constant-growth model). The step-change model suggests the winter-run chinook salmon population currently has a λ of 1.21, while for the constant population growth rate model, $\lambda = 0.97^1$. The extinction risks predicted by the two models are extremely different: winter-run chinook salmon have almost no risk of extinction if the apparent recent increase in λ holds in the future, but are certain to go extinct if the population grows at its average rate, with a most likely time of extinction being 100 years. While it would be dangerous to assume that recent population growth will hold indefinitely, it does appear that the status of winter-run chinook salmon is improving.

Harvest impacts

Substantial changes in ocean fisheries off central and northern California have occurred since the last status review (PFMC 2002a, b). Ocean harvest rate of winter-run chinook salmon is thought to be a function of the Central Valley chinook salmon ocean harvest index (CVI), which is defined as the ratio of ocean catch south of Point Arena to the sum of this catch and the escapement of chinook salmon to Central Valley streams and hatcheries. Note that other stocks (e.g., Klamath chinook salmon) contribute to the catch south of Point Arena, and that fish from the Central Valley are caught in Oregon fisheries. This harvest index ranged from 0.55 to nearly 0.80 from 1970 to 1995, when harvest regimes were adjusted to protect winter-run chinook salmon.. In 2001, the CVI fell to 0.27. The reduction in harvest is presumably at least partly responsible for the record spawning escapement of fall-run chinook salmon ($\approx 540,000$ fish in 2001) and concurrent increases in other chinook salmon runs in the Central Valley.

Because they mature before the ocean fishing season, winter-run chinook salmon should have lower harvest rates than fall-run chinook salmon, if they have similar age-at-maturity. At the time of the last status review, the only information on the harvest rate of winter-run chinook salmon came from a study conducted in the 1970s. Hallock and Fisher (1985) reported that the average catch/(catch+escapement) for the 1969-71 broodyears was 0.40 for the ocean fishery. For the 1968-1975 period, freshwater sport fisheries caught an average of 10% of the winter chinook salmon run.

The recent release of significant numbers of ad-clipped winter-run chinook salmon provides new, but limited, information on the harvest of winter-run chinook salmon in coastal recreational and troll fisheries. The Pacific Fisheries Management Council's Sacramento River Winter and Spring Chinook salmon Workgroup (SRWSCW) conducted a cohort reconstruction of the 1998 broodyear (PFMC 2003). Winter-run chinook salmon are mainly vulnerable to ocean fisheries as 3-year olds. SRWSCW calculated, on the basis of 123 coded-wire-tag recoveries, that the ocean fishery impact rate on 3-year-olds was 0.23, and the in-river sport

¹In this section of the document, λ is defined as $\exp(\mu + \sigma_p^2 / 2)$, the mean annual population growth rate.

fishery impact rate was 0.24. These impacts combine to reduce escapement to $100*(1-0.23)*(1-0.24) = 59\%$ of what it would have been in the absence of fisheries, assuming no natural mortality during the fishing season. The high estimated rate of harvest in the river sport fishery, which arises from the recovery of eight coded-wire tags, was a surprise because salmon fishing is closed from January 15 to July 31 to protect winter-run chinook salmon. The tags were recovered in late December/early January, at the tail end of the fishery for late-fall-run chinook salmon.. The estimate of river sport fishery impact is much less certain than the ocean fishery impact estimate because of the lower number of tag recoveries, less rigorous tag sampling, and larger expansion factors. The California Fish and Game Commission is moving forward with an emergency action to amend sport fishing regulations to ban retention of salmon caught in river sport fisheries on January 1 rather than January 15. Had such regulations been in place in 1999/2000, the freshwater harvest rate would have been 20% of that observed.

New hatchery information

Livingston Stone National Fish Hatchery (LSNFH) was constructed at the base of Shasta Dam in 1997, with the sole purpose of helping to restore natural production of winter-run chinook salmon. LSNFH was designed as a conservation hatchery with features intended to overcome the problems of CNFH (better summer water quality, natal water source). All production is ad-clipped. Each individual considered for use as broodstock is genotyped to ensure that it is a winter-run chinook salmon. No more than 10% of the broodstock is composed of hatchery-origin fish, and no more than 15% of the run is taken for broodstock, with a maximum of 120 fish. Figure 3 shows the number of winter-run chinook salmon released by CNFH/LSNFH; Figure 4 shows the number of winter-run chinook salmon spawners taken into the hatchery.

A.2.8.3 New Comments

The California State Water Contractors, the San Luis and Delta-Mendota Water Authority, and the Westlands Water District recommend that the listing status of winter-run chinook salmon be changed from Endangered to Threatened. They base this proposal on the recent upturn of adult abundance, recently initiated conservation actions (restoration of Battle Creek, ocean harvest reductions, screening of water diversions, remediation of Iron Mountain Mine, and improved temperature control), and a putative shift in ocean climate in 1999.

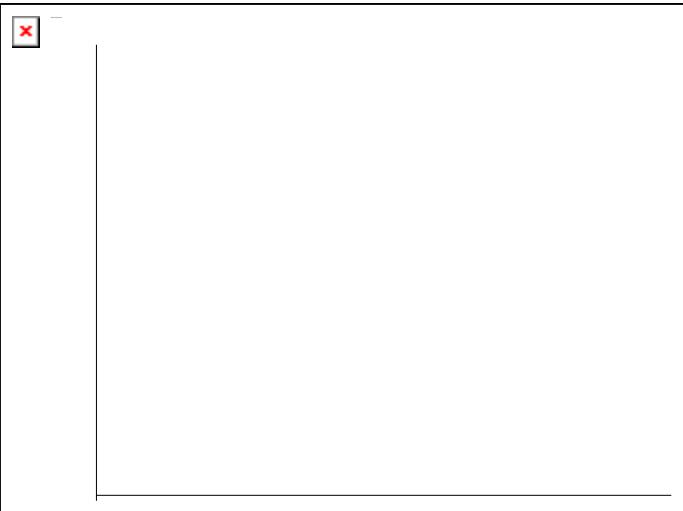


Figure A.2.8.1. Estimated winter-run chinook spawner abundance as determined by RBDD fish ladder (solid line) and carcass mark-recapture (dashed line).

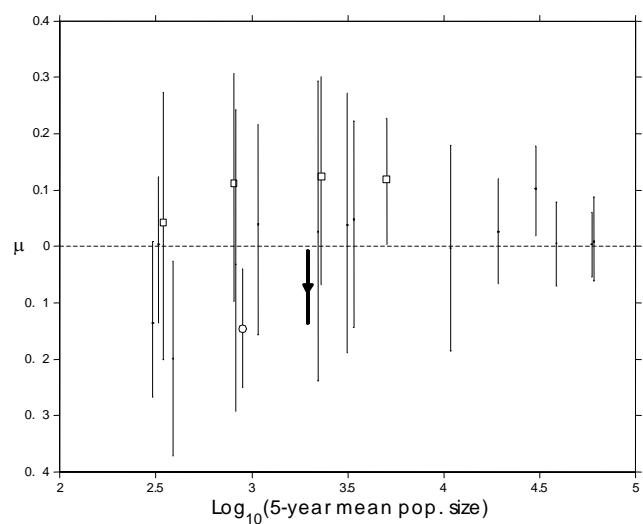


Figure A.2.8.2. Abundance and growth rate of Central Valley salmonid populations. Open circle- steelhead; open squares- spring chinook; filled triangle- winter-run chinook; small black dots- other chinook stocks. Error bars represent central 0.90 probability intervals for μ estimates. (Note: as defined in other sections of the status reviews, $\mu \approx \log(\lambda)$.)

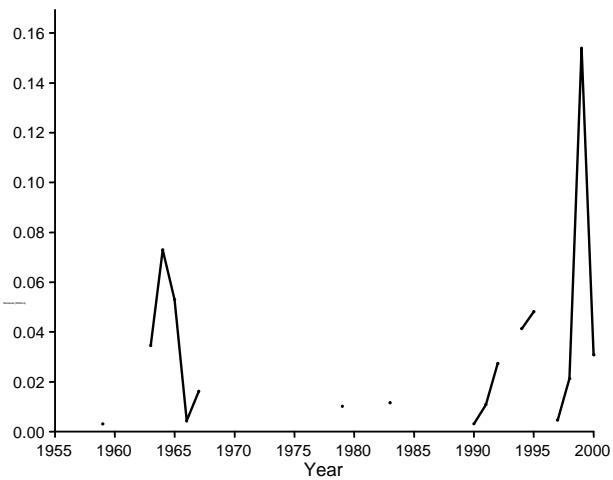


Figure A.2.8.3. Number of juvenile winter-run chinook released by Coleman and Livingston Stone National Fish Hatcheries.



Figure A.2.8.4. Number of adult winter-run chinook collected for broodstock by Coleman and Livingston Stone National Fish Hatcheries.

A.2.9. CENTRAL VALLEY SPRING-RUN CHINOOK SALMON

**Primary contributor: Steven T. Lindley
(Southwest Fisheries Science Center – Santa Cruz Lab)**

A.2.9.1. Summary of Previous BRT Conclusions

The status of Central Valley spring-run chinook salmon was formally assessed during a coastwide status review (Myers et al. 1998). In June 1999, a BRT convened to update the status of this ESU by summarizing information and comments received since the 1997 status review and presenting BRT conclusions concerning four deferred chinook salmon ESUs (NMFS 1999).

Summary of major risk factors and status indicators

Threats to Central Valley (CV) spring-run chinook salmon fall into three broad categories: loss of most historic spawning habitat, degradation of remaining habitat, and genetic threats from the Feather River Hatchery spring-run chinook salmon program. Like most spring-run chinook salmon, CV spring-run chinook salmon require cool water while they mature in freshwater over the summer. In the Central Valley, summer water temperatures are suitable for chinook salmon only above 150-500 m elevation, and most such habitat in the CV is now upstream of impassable dams (Figure A.2.9.1). Only three wild populations of spring-run chinook salmon with consistent spawning runs (on Mill, Deer and Butte Creeks, tributaries to the Lower Sacramento River draining out of the southern Cascades) are extant. These populations reached quite low abundance levels during the late 1980s (5-year mean population sizes of 67-243 spawners), compared to a historic peak abundance of perhaps 700,000 spawners for the ESU (estimate of Fisher [1994], based on early gill-net fishery catches). The Upper Sacramento River supports a small spring-run population, but population status is poorly documented and the degree of hybridization with fall-run chinook salmon is unknown. Of the numerous populations once inhabiting Sierra Nevada streams, only the Feather River and Yuba River populations remain. The Feather River population is dependent on Feather River Hatchery (FRH) production, and may be hybridized with fall-run chinook salmon. Little is known about the status of the spring-run chinook salmon population on the Yuba River other than it appears to be small.

In addition to outright loss of habitat, CV spring-run chinook salmon must contend with the widespread habitat degradation and modification of their rearing and migration habitats in the natal stream, the Sacramento River, and the delta. The natal tributaries do not have large impassable dams like many Central Valley streams, but they do have many small hydropower dams and water diversions that, in some years, have greatly reduced or eliminated in-stream flows during spring-run migration periods. Problems in the migration corridor include unscreened or inadequately screened water diversions, predation by non-native species, and excessively high water temperatures.

The Feather and Yuba Rivers contain populations that are thought to be significantly influenced by the FRH spring-run chinook salmon stock. The FRH spring-run chinook salmon

program releases its production far downstream of the hatchery², causing high rates of straying (CDFG 2001). There is concern that fall-run and spring-run chinook salmon have hybridized in the hatchery. The BRT viewed FRH as a major threat to the genetic integrity of the remaining wild spring-run chinook salmon populations.

² In 2003, CDFG plans to release half of its spring-run chinook production into the river, half into San Pablo Bay.

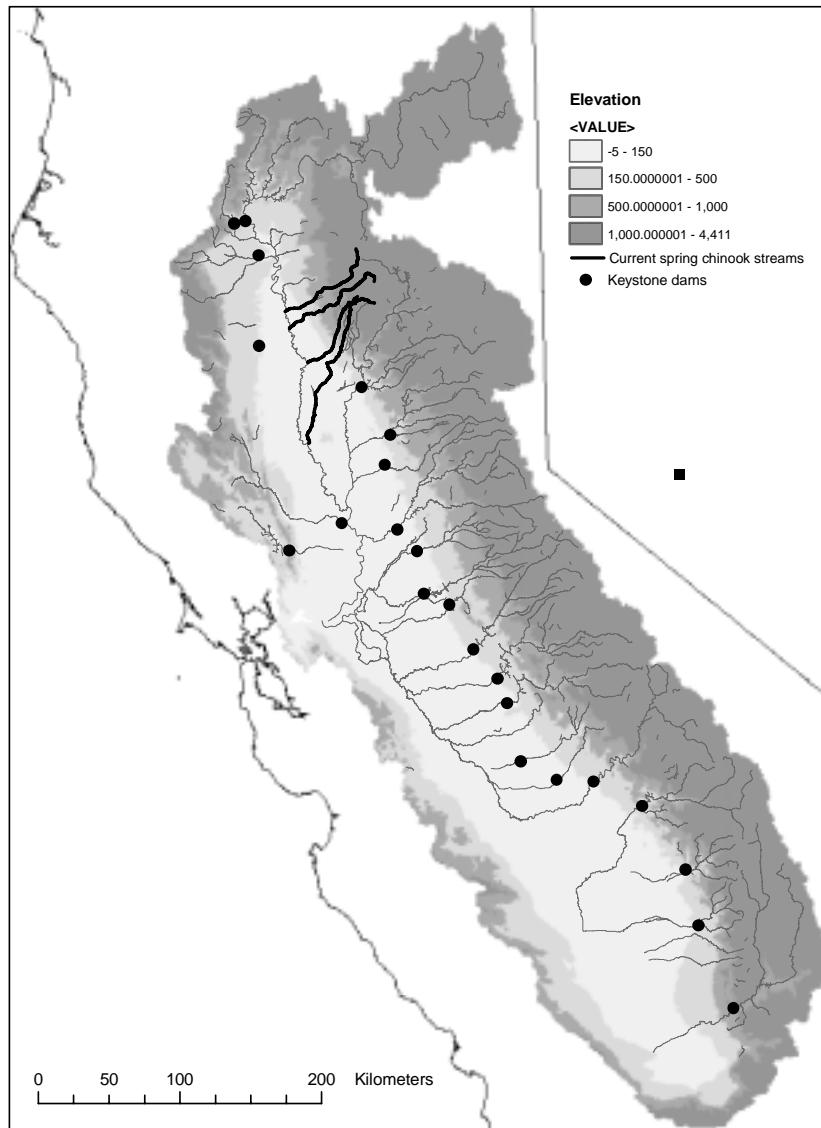


Figure A.2.9.1. Map of Central Valley showing the locations of spring-run chinook salmon populations with consistent runs, plus Big Chico Creek, which in recent years has had a small run. These populations are found in the only watersheds with substantial accessible habitat above 500 m elevation. Keystone dams are the lowest impassable dams on a river or stream.

Previous BRT conclusions

In the original chinook salmon status review, a majority of the BRT concluded that the CV spring-run chinook salmon ESU was in danger of extinction (Myers et al. 1998). Listing of this ESU was deferred, and in the status review update, the BRT majority shifted to the view that this ESU was not in danger of extinction, but was likely to become endangered in the foreseeable future (NMFS 1999). A major reason for this shift was data indicating that a large run of spring-run chinook salmon on Butte Creek in 1998 was naturally produced, rather than strays from FRH.

Listing status

Central Valley spring-run chinook salmon were listed as threatened in 1999. Naturally spawning spring-run chinook salmon in the Feather River were included in the listing, but the Feather River Hatchery stock of spring-run chinook salmon was excluded.

A.2.9.2 New Data and Updated Analyses

Status assessments

In 1998, CDFG reviewed the status of spring-run chinook salmon in the Sacramento River drainage in response to a petition to list these fish under the California Endangered Species Act (CESA) (CDFG 1998). CDFG concluded that spring-run chinook salmon formed an interbreeding population segment distinct from other chinook salmon runs in the Central Valley. CDFG estimated that peak run sizes might have exceeded 600,000 fish in the 1880s, after substantial habitat degradation had already occurred. They blame the decline of spring-run chinook salmon on the early commercial gillnet fishery, water development that blocked access to headwater areas, and habitat degradation. Current risks to the remaining populations include continued habitat degradation related to water development and use, and the operation of FRH. CDFG recommended that Sacramento River spring-run chinook salmon be listed as threatened under the CESA.

Population structure

There are preliminary results for two studies of spring-run chinook salmon population structure. Two important insights are provided by these data sets. First, CV spring-run chinook salmon do not appear to be monophyletic, yet wild CV spring-run chinook salmon populations from different basins are more closely related to each other than to fall-run chinook salmon from the same basin. Second, neither Feather River natural (FR) or Feather River Hatchery (FRH) spring-run chinook salmon are closely related to any of the three wild populations although they are closely related to each other and to CV fall-run chinook salmon.

David Teel of the NWFSC used allozymes to show that Butte and Deer creek spring-run chinook salmon are not closely related to sympatric fall-run chinook salmon populations or the FRH spring-run chinook salmon stock (Figure A.2.9.2). FRH spring-run chinook salmon,

putative Feather River natural spring-run chinook salmon, and Yuba River spring-run chinook salmon fell into a large cluster composed mostly of natural and hatchery fall-run chinook salmon.

Dennis Hedgecock and colleagues, using 12 microsatellite markers, showed that there are two distinct populations of chinook salmon in the Feather River (Hedgecock 2002). One population is formed by early-running (“spring-run”) chinook salmon, the other by late running fish (“fall-run”). Once run timing was accounted for, hatchery and naturally spawning fish appear to form a homogeneous population. The Feather River spring-run population is most closely related to FR fall-run ($F_{st}=0.010$) and to Central Valley fall-run chinook salmon ($F_{st}=0.008$), and is distinct from spring-run chinook salmon in Deer, Mill ($F_{st}=0.016$), and Butte ($F_{st}=0.034$) Creeks. Figure A.2.9.3 shows the neighbor-joining tree with Cavalli-Sforza and Edwards chord distances and unweighted pair-group method arithmetic averaging.

At least two hypotheses could explain the Feather River observations:

1. An ancestral Mill/Deer/Butte-type spring-run chinook salmon was forced to hybridize with the fall-run chinook salmon, producing an intermediate form.
2. The ancestral Feather River spring-run chinook salmon had a common ancestor with the Feather River fall-run chinook salmon, following the pattern seen in Klamath chinook salmon but different from the pattern seen in Deer, Butte, and Mill Creeks. The FR and FRH populations have merged.

Hedgecock argues against the first hypothesis. Feather River fish cluster well within Central Valley fall-run chinook salmon rather than between Mill/Deer/Butte spring-run chinook salmon and Central Valley fall-run chinook salmon, as would be expected under hypothesis 1. Furthermore, there is no evidence from linkage disequilibria that FR spring-run and FR fall-run populations are hybridizing, i.e., these populations are reproductively isolated. It is perhaps not surprising that Feather River spring-run chinook salmon might have a different ancestry than spring-run chinook salmon in Mill, Deer, and Butte Creeks, because the Feather River is in a different ecoregion.

Regardless of the cause of the genetic patterns described above, these new data do not support the current configuration of the CV spring-run chinook salmon ESU. Feather River spring-run chinook salmon do not appear to share a common ancestry or evolutionary trajectory with other spring-run chinook salmon populations in the Central Valley. They share the designation of “spring-run” chinook salmon, and indeed, the Feather River and FRH have a chinook salmon spawning run that starts much earlier than other Sacramento basin rivers. There is no longer a distinct bimodal distribution to run timing, however, and substantial fractions of fish released as FRH spring-run chinook salmon have returned during the fall-run chinook salmon period (and vice versa) (CDFG 1998). If FR and FRH spring-run chinook salmon are retained in the CV spring-run chinook salmon ESU, then the ESU configuration of the CV fall-late-fall-run chinook salmon ESU (among several others) should be reconsidered for the sake of consistency, because late-fall-run chinook salmon are more distinct genetically and arguably as distinct in terms of life history as FRH spring-run chinook salmon.

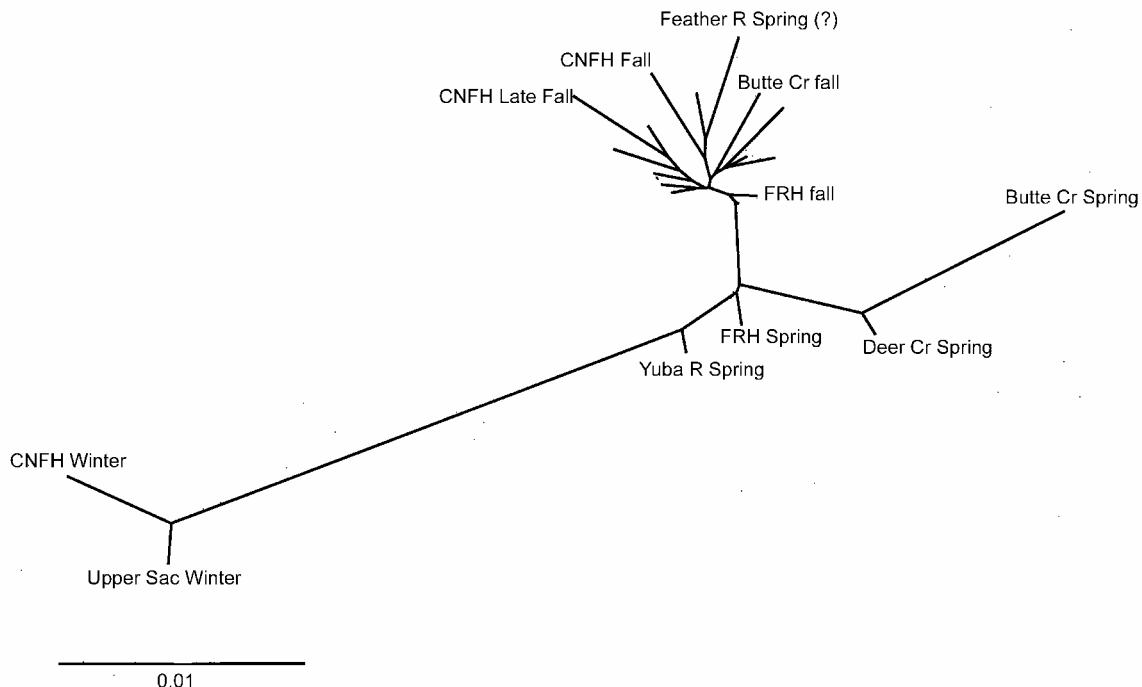


Figure A.2.9.2. Neighbor joining tree (Cavalli-Sforza and Edwards chord distances) for Central Valley chinook salmon populations, based on 24 polymorphic allozyme loci (unpublished data from D. Teel, NWFSC). Populations labeled with only a number are various fall-run chinook salmon populations. The “?” after Feather R Spring indicates that CDFG biologists are not certain that the fish collected for that sample are truly spring-run chinook salmon.

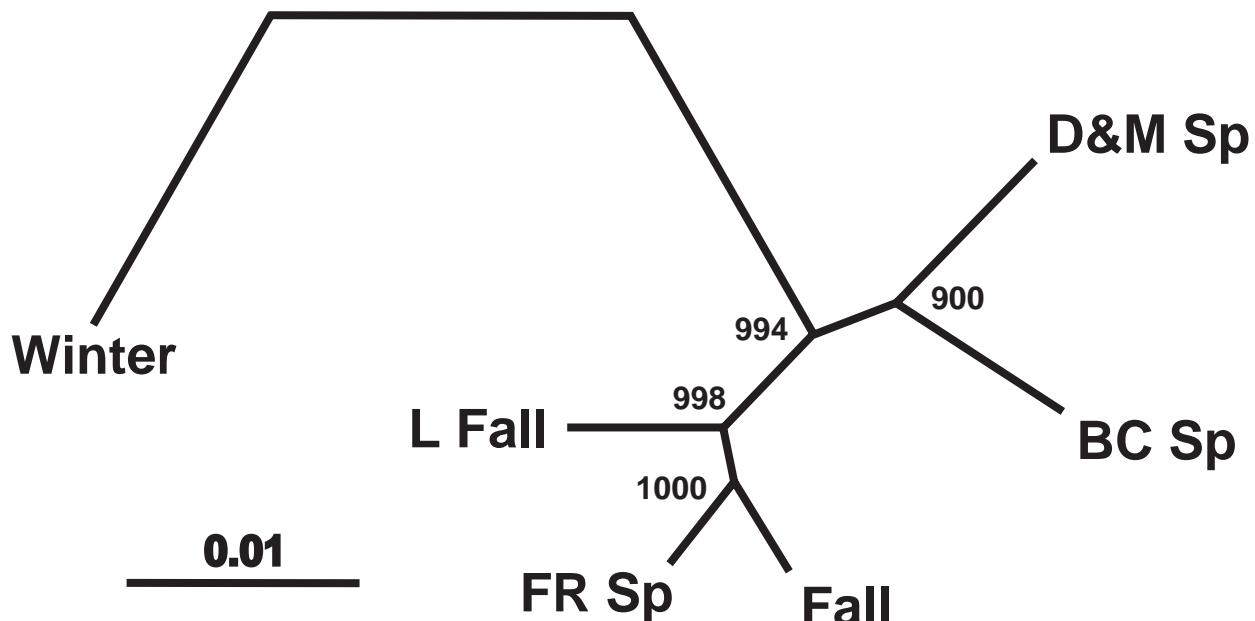


Figure A.2.9.3. Neighbor joining tree (Cavalli-Sforza and Edwards chord distances) for Central Valley chinook salmon populations, based on 12 microsatellite loci. D&M = Deer and Mill Creek; BC = Butte Creek; FR = Feather River; Sp= spring-run chinook salmon; L Fall-run = late-fall-run chinook salmon; Winter = winter-run chinook salmon. The tree was constructed using Cavalli-Sforza and Edwards measure of genetic distance and the unweighted pair-group method arithmetic averaging. Figure from Hedgecock (2002).

Historic habitat loss

Yoshiyama and colleagues detailed the historic distribution of CV spring-run chinook salmon. Yoshiyama et al. (2001) estimated that 72% of salmon spawning and rearing habitat has been lost in the Central Valley. This figure is for fall-run as well as spring-run chinook salmon, so the amount of spring-run chinook salmon habitat lost is presumably higher because spring-run chinook salmon spawn and rear in higher elevations, areas more likely to be behind impassable dams. They deem the 95% loss estimate of CDFG (Reynolds et al. 1993) as “perhaps somewhat high but probably roughly accurate.”

Life history

CDFG recently began intensive studies of Butte Creek spring-run chinook salmon (Ward et al. 2002). One of the more interesting observations is that while the great majority of spring-run chinook salmon leave Butte Creek as young-of-the-year, yearling outmigrants make up roughly 25% of the ocean catch of Butte Creek spring-run chinook salmon.

Harvest information

Substantial changes in ocean fisheries off central and northern California have occurred since the last status review (PFMC 2002a, b). Ocean harvest rate of CV spring-run chinook

salmon is thought to be a function of the Central Valley chinook salmon ocean harvest index (CVI), which is defined as the ratio of ocean catch south of Point Arena to the sum of this catch and the escapement of chinook salmon to Central Valley streams and hatcheries. Note that other stocks (e.g., Klamath chinook salmon) contribute to the catch south of Point Arena. This harvest index ranged from 0.55 to nearly 0.80 from 1970 to 1995, when harvest regimes were adjusted to protect winter-run chinook salmon. In 2001, the CVI fell to 0.27. The reduction in harvest is presumably at least partly responsible for the record spawning escapement of fall-run chinook salmon (\approx 540,000 fish in 2001) and recent increases in spring-run populations.

Coded-wire tagging of juvenile spring-run chinook salmon in Butte Creek provides some limited information on the ocean distribution of this population; there have not yet been enough tag recoveries for a full cohort reconstruction. Butte Creek spring-run chinook salmon have a more northerly distribution than winter-run chinook salmon (PFMC 2003), with recoveries off of Oregon and in the Klamath Management Zone and Fort Bragg areas. The majority of recoveries have been south of Point Arena.

Abundance data

The time series of abundance for Mill, Deer, Butte, and Big Chico Creek spring-run chinook salmon have been updated through 2001, and show that the increases in population that started in the early 1990s has continued (Figure A.2.9.4). During this period, there have been significant habitat improvements (including the removal of several small dams and increases in summer flows) in these watersheds, as well as reduced ocean fisheries and a favorable terrestrial and marine climate.

The time series for Butte, Deer, and Mill Creeks are barely amenable to simple analysis with the random walk-with-drift model (Homes 2001, Lindley in press). The data series are short, and inconsistent methods were used until 1992, when a consistent snorkel survey was initiated on Butte and Deer Creeks. The full records for these three systems are analyzed with the knowledge that there may be significant errors in pre-1992 observations. Table A.2.9.1 summarizes the analyses of these time series.

It appears that the three spring-run chinook salmon populations in the Central Valley are growing. The current 5-year geometric means for all three populations are also the maximum 5-year means. All three spring-run chinook salmon populations have long- and short-term $\lambda > 1$ (λ is defined as $\exp(\mu + \sigma_p^2 / 2)$ —the *mean* annual population growth rate in this document), with lower bounds of 90% confidence intervals generally > 1 . Long- and short-term trends are also positive, although some confidence interval lower bounds are negative. CV spring-run chinook salmon have some of the highest population growth rates in the Central Valley, but other than Butte Creek and the hatchery-influenced Feather River, population sizes are relatively small compared to fall-run chinook salmon populations (Figure A.2.9.5).

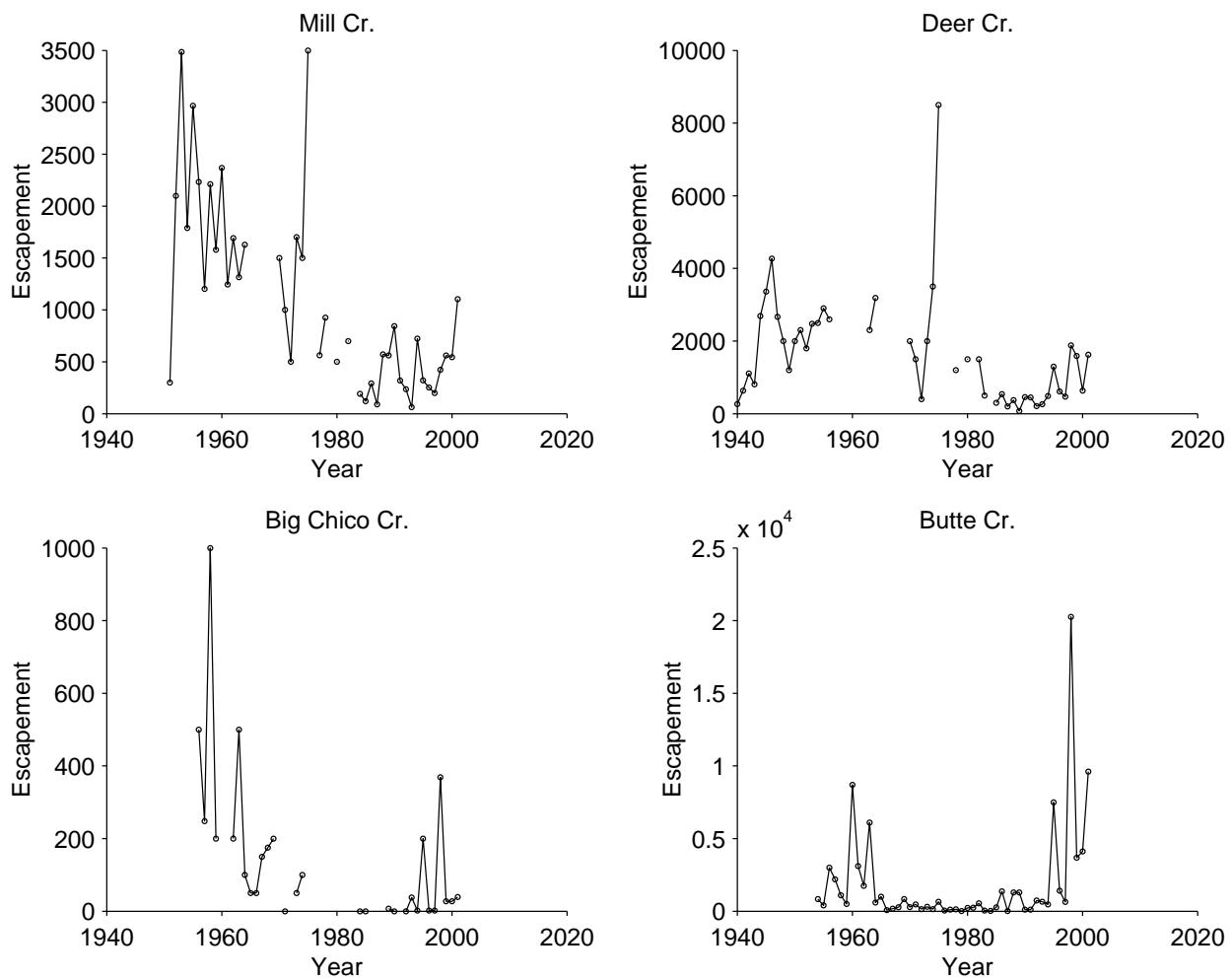


Figure A.2.4. Time series of population abundance for Central Valley spring-run chinook salmon.

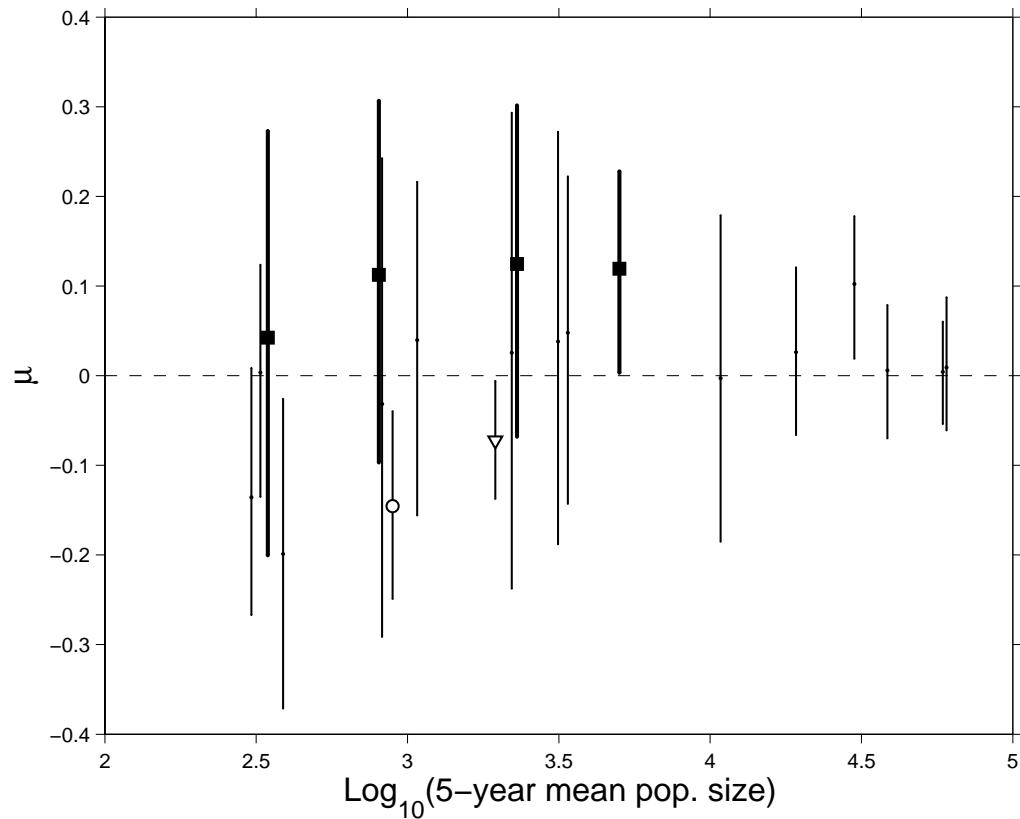


Figure A.2.5. Abundance and growth rate of Central Valley salmonid populations. Open circle- steelhead; filled squares- spring-run chinook salmon; open triangle- winter-run chinook salmon; small black dots- other chinook salmon stocks (mostly fall runs). Error bars represent central 0.90 probability intervals for μ estimates. (Note: as defined in other sections of the status reviews, $\mu \approx \log [\lambda]$.)

Table A.2.9.1. Summary statistics for trend analyses. Numbers in parentheses are 0.90 confidence intervals.

Population	5-yr mean	5-yr min	5-yr max	λ	μ	LT trend	ST trend
Sacramento River winter-run chinook	2,191	364	65,683	0.97 (0.87, 1.09)	-0.10 (-0.21, 0.01)	-0.14 (-0.19, -0.09)	0.26 (0.04, 0.48)
Butte Creek spring-run chinook	4,513	67	4,513	1.30 (1.09, 1.60)	0.11 (-0.05, 0.28)	0.11 (0.03, 0.19)	0.36 (0.03, 0.70)
Deer Creek spring-run chinook	1,076	243	1,076	1.17 (1.04, 1.35)	0.12 (-0.02, 0.25)	0.11 (0.02, 0.21)	0.16 (-0.01, 0.33)
Mill Creek spring-run chinook	491	203	491	1.19 (1.00, 1.47)	0.09 (-0.07, 0.26)	0.06 (-0.04, 0.16)	0.13 (-0.07, 0.34)

New Hatchery Information

FRH currently aims to release 5 million spring-run chinook salmon smolts per year although actual releases have been mostly lower than this goal (Figure A.2.9.6). Returns to the hatchery appear to be directly proportional to the releases (Figure A.2.9.7).

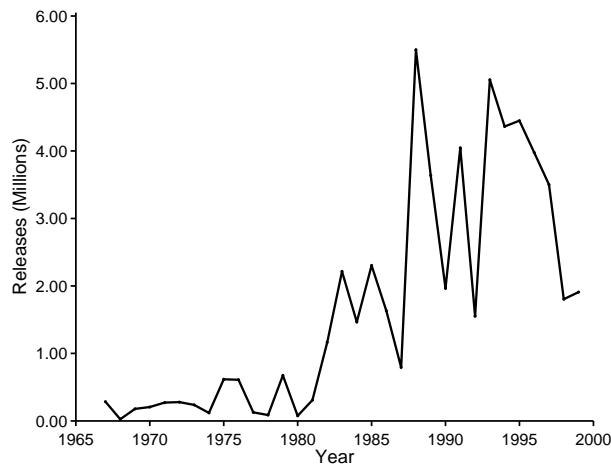


Figure A.2.9.6. Number of spring-run chinook salmon released by Feather River Hatchery.

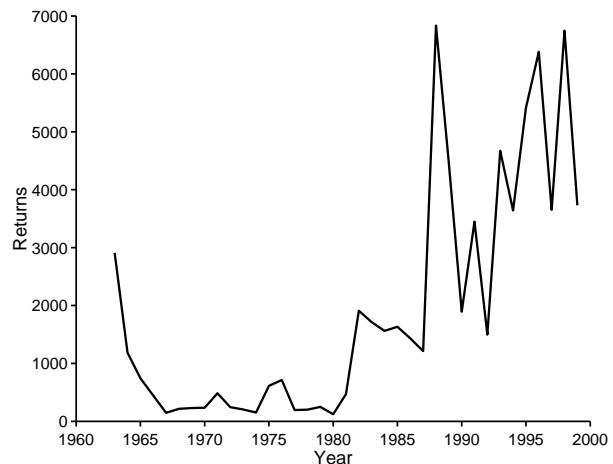


Figure A.2.9.7. Number of spring-run chinook salmon returning to Feather River Hatchery.

New Comments

The State Water Contractors (SWC) submitted several documents, one of them relevant to the status review for CV spring-run chinook salmon. The document, “Reconsideration of the listing status of spring-run chinook salmon within the Feather River portion of the Central Valley ESU,” argues that Feather River spring-run chinook salmon should not be included in the CV spring-run chinook salmon ESU and do not otherwise warrant protection under the ESA. SWC also suggested that NMFS conduct a series of evaluations of the following topics:

1. impact of hatchery operations on the population dynamics and the genetic integrity of natural stocks
2. hatcheries as conservation
3. effects of mixed-stock fisheries
4. assessment of the relative roles of different mortality factors
5. experimental assessment of the effects of river operations
6. efficacy of various habitat improvements
7. stock identification for salvage and ocean fishery management
8. constant fractional marking

The California Farm Bureau Federation (CFBF) submitted comments with several attachments calling for the removal of most salmonid ESUs from the endangered species list. The attachments included: 1) an analysis by B.J. Miller showing that significant and expensive

changes to water operations in the delta provide fairly modest benefits to chinook salmon populations; 2) “Reconsideration of the listing status of spring-run chinook salmon within the Feather River portion of the Central Valley ESU,” discussed in the preceding paragraph; 3) a memo from J.F. Palmisano to C.H. Burley arguing that because changes in marine climate have been shown to influence salmon stocks, other putative causes for declines of salmonid populations must be over-rated. CFBF reviews *Alsea Valley Alliance v. Evans* and argues that hatchery fish must be included in risk analyses.

A.2.9.3 Comparison with Previous Data

The upward trends in abundance of the Mill, Deer, and Butte Creek populations noted in the most recent previous status review (NMFS 1999) have apparently continued, probably due in part to the combined effects of habitat restoration, reduced fishing effort in the ocean, and favorable climatic conditions. New population genetics information confirms previous suspicions that Feather River hatchery and Feather River spring-run chinook salmon are not closely related to the Mill, Deer, and Butte Creek spring-run chinook salmon populations.

A.3 CHINOOK SALMON BRT CONCLUSIONS

Snake River fall-run chinook salmon ESU

A majority (60%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table A.3.1). This represented a somewhat more optimistic assessment of the status of this ESU than was the case at the time of the original status review, when the BRT concluded that Snake River fall-run chinook salmon “face a substantial risk of extinction if present conditions continue” (Waples et al. 1991). The BRT found moderately high risks in all VSP elements, with mean risk matrix scores ranging from 3.0 for growth rate/productivity to 3.6 for spatial structure (Table A.3.2).

On the positive side, the number of natural origin spawners in 2001 was well in excess of 1000 for the first time since counts at Lower Granite Dam began in 1975. Management actions have reduced (but not eliminated) the fraction of fish passing Lower Granite Dam that are strays from out-of-ESU hatchery programs. Returns in the last two years also reflect an increasing contribution from supplementation programs based on the native Lyons Ferry Broodstock. With the exception of the increase in 2001, the ESU has fluctuated between approximately 500-1000 adults, suggesting a somewhat higher degree of stability in growth rate and trends than is seen in many other salmon populations.

In spite of the recent increases, however, the recent geometric mean number of naturally produced spawners is still less than 1000, a very low number for an entire ESU. Because of the large fraction of naturally spawning hatchery fish, it is difficult to assess the productivity of the natural population. The relatively high risk matrix scores for spatial structure and diversity (3.5-3.6) reflect the concerns of the BRT that a large fraction of historic habitat for this ESU is inaccessible, diversity associated with those populations has been lost, the single remaining population is vulnerable to variable environmental conditions or catastrophes, and continuing immigration from outside the ESU at levels that are higher than occurred historically. Some BRT members were concerned that the efforts to remove stray, out-of-ESU hatchery fish only occur at Lower Granite Dam, well upstream of the geographic boundary of this ESU. Specific concerns are that natural spawners in lower river areas will be heavily affected by strays from Columbia River hatchery programs, and that this approach effectively removes the natural buffer zone between the Snake River ESU and Columbia River ocean-type chinook salmon. The effects of these factors on ESU viability are not known, as the extent of natural spawning in areas below Lower Granite Dam is not well understood, except in the lower Tucannon River.

Snake River spring/summer-run chinook salmon ESU

About two-thirds (68%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table A.3.1). As indicated by mean risk matrix scores, the BRT had much higher concerns about abundance (3.6) and growth rate/productivity (3.5) than for spatial structure (2.2) and diversity (2.3) (Table A.3.2).

Although there are concerns about loss of an unquantified number of spawning aggregations that historically may have provided connectivity between headwater populations, natural spawning in this ESU still occurs in a wide range of locations and habitat types.

Like many others, this ESU saw a large increase in escapement in many (but not all) populations in 2001. The BRT considered this an encouraging sign, particularly given the record low returns seen in many of these populations in the mid 1990s. However, recent abundance in this ESU is still short of the levels that the proposed recovery plan for Snake River salmon indicated should be met over at least an eight year period (NMFS 1995). The BRT considered it a positive sign that the non-native Rapid River broodstock has been phased out of the Grande Ronde system, but the relatively high level of both production/mitigation and supplementation hatcheries in this ESU leads to ongoing risks to natural populations and makes it difficult to assess trends in natural productivity and growth rate.

Upper Columbia River spring-run chinook salmon ESU

Assessments by the BRT of the overall risks faced by this ESU were divided, with a slight majority (53%) of the votes being cast in the “danger of extinction” category and a substantial minority (45%) in the “likely to be endangered” category (Table A.3.1). The mean risk matrix scores reflect strong ongoing concerns regarding abundance (4.4) and growth rate/productivity (4.5) in this ESU and somewhat less (but still significant) concerns for spatial structure (2.9) and diversity (3.5) (Table A.3.2).

Many populations in this ESU have rebounded somewhat from the critically low levels that immediately preceded the last status review evaluation, and this was reflected in the substantial minority of BRT votes cast that were not cast in the “danger of extinction” category. Although this was considered an encouraging sign by the BRT, the last year or two of higher returns come on the heels of a decade or more of steep declines to all time record low escapements. In addition, this ESU continues to have a very large influence by hatchery production, both from production/mitigation and supplementation programs. The extreme management measures taken in an effort to maintain populations in this ESU during some years in the late 1990s (collecting all adults from major basins at downstream dams) are a strong indication of the ongoing risks to this ESU, although the associated hatchery programs may ultimately play a role in helping to restore self-sustaining natural populations.

Lower Columbia River chinook salmon ESU

A majority (71%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table A.3.1). Moderately high concerns for all VSP elements are indicated by mean risk matrix scores ranging from 3.2 for abundance to 3.9 for diversity (Table A.3.2).

All of the risk factors identified in previous reviews were still considered important by the BRT. The Willamette/Lower Columbia River TRT has estimated that 8-10 historic populations

in this ESU have been extirpated, most of them spring-run populations. Near loss of that important life history type remains in important BRT concern. Although some natural production currently occurs in 20 or so populations, only one exceeds 1000 spawners. High hatchery production continues to pose genetic and ecological risks to natural populations and to mask their performance. Most populations in this ESU have not seen as pronounced increases in recent years as occurred in many other geographic areas.

Upper Willamette River chinook salmon ESU

A majority (70%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table A.3.1). The BRT found moderately high risks in all VSP elements (mean risk matrix scores ranged from 3.1 for growth rate/productivity to 3.6 for spatial structure) (Table A.3.2).

Although the number of adult spring-run chinook salmon crossing Willamette Falls is in the same range (about 20,000–70,000) it has been for the last 50 years, a large fraction of these are hatchery produced. The score for spatial structure reflects concern by the BRT that perhaps a third of the historic habitat used by fish in this ESU is currently inaccessible behind dams, and the BRT remained concerned that natural production in this ESU is restricted to a very few areas. Increases in the last 3-4 years in natural production in the largest remaining population (the McKenzie) were considered encouraging by the BRT. With the relatively large incidence of hatchery fish, it is difficult to determine trends in natural production.

Puget Sound chinook salmon ESU

A majority (74%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table A.3.1). The BRT found moderately high risks in all VSP elements, with mean risk matrix scores ranging from 2.9 for spatial structure to 3.6 for growth rate/productivity (Table A.3.2).

Most population indices for this ESU have not changed substantially since the last BRT assessment. The Puget Sound TRT has identified approximately 31 historic populations, of which 9 are believed to be extinct, with most of the populations that have been lost being early run. Other concerns noted by the BRT are the concentration of the majority of natural production in just two basins, high levels of hatchery production in many areas of the ESU, and widespread loss of estuary and lower floodplain habitat diversity (and, likely, associated life history types). Although populations in this ESU have not experienced the sharp increases in the last 2-3 years seen in many other ESUs, more populations increased than decreased over the 4 years since the last BRT assessment. After adjusting for changes in harvest rates, however, trends in productivity are less favorable. Most populations are relatively small, and recent natural production within the ESU is only a fraction of estimated historic run size. On the positive side, harvest rates for all populations have been reduced from their peaks in the 1980s, and some hatchery reforms have been implemented (e.g., elimination of many net pen programs that were leading to widespread straying, and transition of other programs to more local

broodstocks). The BRT felt that these management changes should help facilitate recovery if other limiting factors (especially habitat degradation) are also addressed. The BRT felt that the large recovery effort organized around the Puget Sound Shared Strategy was a positive step because it could help to link and coordinate efforts in many separate, local watersheds.

California Coastal chinook salmon ESU

A majority (67%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with votes falling in the “danger of extinction” category outnumbering those in “not warranted” category by nearly 2-to-1 (Table A.3.1). The BRT found moderately high risks in all VSP elements, with mean risk matrix scores ranging from 3.1 for diversity to 3.9 for abundance (Table A.3.2).

The BRT was concerned by continued evidence of low population sizes relative to historical abundance and mixed trends in the few time series of abundance indices available for analysis, and by the low abundances and potential extirpations of populations in the southern part of the ESU. The BRT’s concerns regarding genetic integrity of this ESU were moderate or low relative to similar issues for other ESUs because 1) hatchery production in this ESU is on a minor scale, and 2) current hatchery programs are largely focused on supplementing and restoring local populations. However, the BRT did have concerns with respect to diversity that were based largely on the loss of spring-run chinook salmon in the Eel River basin and elsewhere in the ESU, and to a lesser degree on the potential loss of diversity concurrent with low abundance or extirpation of populations in the southern portion of the ESU. Overall, the BRT was strongly concerned by the paucity of information and resultant uncertainty associated with estimates of abundance, natural productivity and distribution of chinook salmon in this ESU.

Sacramento River winter-run chinook salmon ESU

A majority (60%) of the BRT votes fell into the “in danger of extinction” category, with a minority (38%) voting for the “likely to become endangered” and only 2% voting for “not warranted.” (Table A.3.1). The main VSP concerns were in the spatial structure and diversity categories (4.8 and 4.2, respectively), although there was significant concern in the abundance and productivity categories (3.7 and 3.5, respectively) (Table A.3.2).

The main concerns of the BRT relate to the lack of diversity within this ESU. The BRT was very troubled by the fact that this ESU is represented by a single population that has been displaced from its historic spawning habitat into an artificial habitat created and maintained by a dam. The BRT presumed that several independent populations of winter-run chinook salmon were merged into a single population, with the potential for a significant loss of life history and genetic diversity. Furthermore, the population has passed through at least two recent bottlenecks—one when Shasta Dam was filled and another in the late 1980s-early 1990s—that probably further reduced genetic diversity. The population has been removed from the environment where it evolved, dimming its long-term prospects for survival. The BRT was modestly heartened by the increase in abundance since the lows of the late 1980s and early 1990s.

Central Valley spring-run chinook salmon ESU

A large majority (69%) of the BRT votes fell into the “likely to become endangered” category, with a minority (27%) of votes going to “in danger of extinction” and 4% “not warranted” (Table A.3.1). There was roughly equal concern about abundance, spatial structure and diversity (3.5-3.8), and less concern about productivity (2.8) (Table A.3.2).

A major concern of the BRT was the loss of diversity caused by the extirpation of spring-run chinook salmon populations from most of the Central Valley, including all San Joaquin tributaries. The only populations left in the Sierra Nevada ecoregion are supported by the Feather River hatchery. Another major concern of the BRT was the small number and location of extant spring-run chinook salmon populations-- only three streams, originating in the southern Cascades, support self-sustaining runs of spring-run chinook salmon, and these three streams are close together, increasing their vulnerability to catastrophe. Two of the three extant populations are fairly small, and all were recently quite small. The BRT was also concerned about the Feather River spring-run chinook salmon hatchery population, which is not in the ESU but does produce fish that potentially could interact with other spring-run chinook salmon populations, especially given the off-site release of the production.

Table A.3.1. Tally of FEMAT vote distribution regarding the status of 9 chinook salmon ESUs reviewed by the chinook salmon BRT.
Each of 15 BRT members allocated 10 points among the three status categories.

ESU	At Risk of Extinction	Likely to Become Endangered	Not Likely to Become Endangered
Snake River fall-run	38	91	21
Snake River spring/summer-run	30	102	18
Upper Columbia River spring-run	79	67	4
Puget Sound	12	111	27
Lower Columbia River	25	107	18
Upper Willamette River	32	105	13
California Coastal ¹	36	100	13
Sacramento River winter-run ²	78	49	3
CA Central Valley spring-run ²	35	90	5
One BRT member assigned 9 points	2 Votes tallied for 13 BRT members		

Table A.3.2. Summary of risk scores (1 = low to 5 = high) for four VSP categories (see section "Factors Considered in Status Assessments" for a description of the risk categories) for the 9 chinook salmon ESUs reviewed. Data presented are means (range).

ESU	Abundance	Growth Rate/Productivity	Spatial Structure and Connectivity	Diversity
Snake River fall-run	3.4 (2-5)	3.0 (2-5)	3.6 (2-5)	3.5 (2-5)
Snake River spring/summer-run	3.6 (2-5)	3.5 (3-5)	2.2 (1-3)	2.3 (1-3)
Upper Columbia River spring-run	4.4 (3-5)	4.5 (3-5)	2.9 (2-4)	3.5 (2-5)
Puget Sound	3.3 (2-4)	3.6 (3-4)	2.9 (2-4)	3.2 (2-4)
Lower Columbia River	3.2 (2-4)	3.7 (3-5)	3.5 (3-4)	3.9 (3-5)
Upper Willamette River	3.7 (2-5)	3.1 (2-5)	3.6 (3-4)	3.2 (2-4)
California Coastal ¹	3.9 (3-5)	3.3 (3-4)	3.2 (2-4)	3.1 (2-4)
Sacramento River winter-run ²	3.7 (3-5)	3.5 (2-5)	4.8 (4-5)	4.2 (3-5)
CA Central Valley spring-run ²	3.5 (3-4)	2.8 (2-4)	3.8 (3-5)	3.8 (3-5)

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A.5 APPENDICES

Appendix A.5.1. SSHAG (2003) categorizations of hatchery populations of the nine chinook salmon ESUs reviewed. See “Artificial Propagation” in General Introduction for explanation of the categories.

	Stock	Run	Basin	SSHAG Category
Snake River fall-run	Lyons Ferry	Fall	Snake River	2a
Snake River spring/summer-run	McCall (supplementation)	Spring	Salmon	1a
	McCall (production)	Spring	Salmon	2a
	Rapid River	Spring	Little Salmon	3c
	Sawtooth	Spring	Salmon	1a
	Pahsimeroi	Summer	Salmon	1a and 2a
	Captive Broodstock			
<i>Catherine Creek</i>	Summer	Grande Ronde	1a	
<i>Upper Grande Ronde</i>	Summer	Grande Ronde	1a	
<i>Lostine River</i>	Summer	Grande Ronde	1a	
	Clearwater	Spring	Clearwater	2b
	Imnaha (# 29)	Spr/Sum	Imnaha	1a
	Dworschak	Spring	Clearwater	3b or 4
	Kooskia	Spring	Clearwater	3b or 4
	Tucannon	Spring	Tucannon	1a
Upper Columbia River spring-run	Leavenworth NFH	Spring	Wenatchee	3c or 4
	Entiat NFH	Spring	Entiat	3c, 4, or 2b
	Winthrop NFH	Spring	Methow	3c or 4
	Chiwawa	Spring	Wenatchee	1a
	Methow Composite	Spring	Methow	2a/c
	<i>Twisp</i>	Spring	Methow	1a
	<i>Chewuch</i>	Spring	Methow	1a
	<i>Methow</i>	Spring	Methow	3c or 4
	U. Columbia River Captive			
	<i>Nason</i>	Spring	Wenatchee	1a
	<i>White River</i>	Spring	Wenatchee	1a
Appendix A.5.1 (cont.)				

	<i>Twisp</i>	Spring	Methow	1a
	<i>Methow</i>	Spring	Methow	1a
	<i>Ringold Hatchery</i>	Spring	U. Col. River	3c or 4
	<i>Carson Hatchery</i>	Spring	Wind	3c or 4
Puget Sound	<i>Kendall Creek</i>	Spring	Nooksack	2a
	<i>Lummi Bay</i>	Fall	Nooksack	3b or 3c
	<i>Samish River</i>	Fall	Samish	3b
	<i>Marblemount</i>	Spring	Skagit	2c
	<i>Marblemount</i>	Summer	Skagit	1a
	<i>Marblemount</i>	Fall	Skagit	1a
	<i>Tulalip</i>	Spring	Tulalip Bay	3b or 3c
	<i>Tulalip</i>	Summer	Tulalip Bay	2b or 2c
	<i>Tulalip</i>	Fall	Tulalip Bay	3b or 3c
	<i>N. Fork Stillaguamish</i>	Summer	Stillaguamish	1a
	<i>Wallace River</i>	Summer	Snohomish	2a
	<i>Isaquah Hatchery</i>	Fall	Lake Washington	2b
	<i>UW Portage Bay</i>	Fall	Lake Washington	3b or 4
	<i>Soos Creek</i>	Fall	Green	2a
	<i>Keta Creek</i>	Fall	Green	2a
	<i>Grover's Creek</i>	Fall	East Kitsap	2b
	<i>Garrison Springs</i>	Fall	Chambers Creek	2b
	<i>Voights Creek</i>	Fall	Puyallup	2b or 2c
	<i>Diru Creek</i>	Fall	Puyallup	2b or 2c
	<i>White River</i>	Spring	Puyallup	2a
	<i>Clear/Kalama Creeks</i>	Fall	Nisqually	2a or 2b
	<i>Minter Creek</i>	Fall	S. Sound	2b
	<i>Tunwater Falls</i>	Fall	Deschutes	2b
	<i>George Adams</i>	Fall	Skokomish	2b or 3c
	<i>WSC Hood Canal</i>	Fall	Skokomish	2b or 3c
	<i>Finch Creek</i>	Fall	S. Hood Canal	2b or 3c
	<i>Hamma Hamma</i>	Fall	S. Hood Canal	2b or 3c
	<i>Big Beef Creek</i>	Fall	N. Hood Canal	2b
Appendix A.5.1 (cont.)	<i>Dungeness</i>	Spring	Dungeness	1a

	Elwha	Fall	Elwha	2a
Glenwood Springs	Fall	San Juan Islands	2b	
Sea Resources	Fall	Chinook River	2b	
Abernathy NFH	Fall	Abernathy Creek	2b	
Grays River	Fall	Grays	2b	
Elochoman	Fall	Elochoman	2b	
Cowlitz	Fall	Cowlitz	2a	
Cowlitz	Spring	Cowlitz	2a	
Toutle	Spring	Cowlitz	2c	
Kalama	Fall	Kalama	2a	
Kalama	Spring	Kalama	2b	
Lewis	Spring	Lewis	2a or 2b	
Washougal	Fall	Washougal	2a or 2b	
Carson	Spring	Wind	4	
LWS NFH	Fall	Little White	4	
Spring Creek NFH	Fall	Spring Creek	2a	
Klickitat	Fall	Klickitat	4	
Willamette	Spring	Youngs Bay	4	
Big Creek	Fall	Big Creek	3b	
Rogue River (#52)	Fall	Youngs Bay	4	
Klaskanine (# 15)	Fall	Klaskanine	2b	
Willamette	Spring	Klaskanine	4	
Bonneville (#14)	Fall	Gorge	3a	
Bonneville (#95)	Fall	Gorge	4	
Hood River	Spring	Hood	4	
N. Fork Santiam (#21)	Spring	Santiam	2a and 2b	
Willamette Hatchery (#22)	Spring	M. Fork Willamette	2b or 2c	
McKenzie (#24)	Spring	McKenzie	2a	
S. Fork Santiam (#23)	Spring	Santiam	2b	
Clackamas (# 19)	Spring	Clackamas	2b or 2c	
Appendix A.5.1 (cont.)				
California Coastal	Mad River	Mad River	2q,b,c	
Freshwater Creek	Fall	Humboldt Bay	1a	

	Yaeger Creek	Fall	Van Duzen	1a
	Redwood Creek	Fall	Redwood Creek	1a
	Hollow Tree Creek	Fall	Eel River	1a
	Van Arsdale	Fall	Eel River	2a
	Mattole	Fall	Mattole River	1a
Sacramento River winter-run	Livingston Stone	Winter	Sacramento River	1a
California Central Valley spring-run	Feather River	Spring	Feather River	4 or 2b

Appendix A.5.2. Chinook Salmon Time Series Data Sources

Snake River Fall Chinook Salmon ESU

Population	Snake River fall-run
Years of Data, Length of Series	1975 - 2001, 27 years
Abundance Type	Dam count
Abundance Notes / References	Used run reconstruction spreadsheet (Henry Yuen, USFWS) to update PATH data set (Marmorek et al., 1998)
Hatchery Notes / Reference	Used run reconstruction spreadsheet (Henry Yuen, USFWS) to update PATH data set (Marmorek et al., 1998)
Harvest Notes / Reference	Used run reconstruction spreadsheet (Henry Yuen, USFWS) to update PATH data set (Marmorek et al., 1998)
Age Notes / Reference	Used run reconstruction spreadsheet (Henry Yuen, USFWS) to update PATH data set (Marmorek et al., 1998)

Snake River Spring/Summer Chinook ESU

Population	Snake River spring-run total
Years of Data, Length of Series	1979 - 2001, 23 years
Abundance Type	Dam Count
Abundance Notes / Reference	Beamesderfer et al 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Hatchery Notes / Reference	Beamesderfer et al 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Harvest Notes / Reference	U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Age Notes / Reference	Average from Beamesderfer et al. 1998

Population	Snake River summer-run total
Years of Data, Length of Series	1979 - 2001, 23 years
Abundance Type	Dam Count
Abundance Notes / Reference	Beamesderfer et al 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Hatchery Notes / Reference	Beamesderfer et al 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Harvest Notes / Reference	U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Age Notes / Reference	Yearly data from Beamesderfer et al. 1998, recent years updated with an average

Population	Alturas Lake Creek
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Redd Count

Abundance Notes / Reference	Elms-Cockrom 1998, Kiefer 2002 (1999-2001)
Hatchery Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Harvest Notes / Reference	Myers et al. 1998 (org. citation is Kiefer et al. 1992), used Salmon River age structure
Age Notes / Reference	
Population	Bear Valley / Elk Creek
Years of Data, Length of Series	1960 - 2001, 42 years
Abundance Type	Expanded Redd Count
Abundance Notes / Reference	Beamesderfer et al 1998, IDFG updated redd counts
Hatchery Notes / Reference	Beamesderfer et al 1998
Harvest Notes / Reference	CTC db from Tom G.
Age Notes / Reference	IDFG, used MF composite to fill in missing years
Population	Big Creek summer-run
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Redd Count
Abundance Notes / Reference	Streamnet 2000, Brown 2002 (1998-2001)
Hatchery Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Harvest Notes / Reference	MF Composite Age Data
Age Notes / Reference	
Population	Big Sheep Creek
Years of Data, Length of Series	1957 - 2001, 39 years
Abundance Type	Redd Count
Abundance Notes / Reference	Abundance database reference #52 (all years prior to 1997), Keniry 2002 (1997-2001)
Hatchery Notes / Reference	12 ESU's data file, Eli Holmes, NWFSC
Harvest Notes / Reference	Beamesderfer et al 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Age Notes / Reference	Beamesderfer et al. 1998
Population	Camas Creek
Years of Data, Length of Series	1972 - 2001, 29 years
Abundance Type	Redd Count
Abundance Notes / Reference	1998-2001 redd counts: 2002 IDFG comment letter
Hatchery Notes / Reference	12 ESU's data file, Eli Holmes, NWFSC
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Age Notes / Reference	Middle Fork composite age data
Population	Catherine Cr (Index Area)

Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Redd Count
Hatchery Notes / Reference	Abundance database reference #52, ODFW 1997, Keniry 2002 (1997-2001) 12 ESU's data file, Eli Holmes, NWFSC
Harvest Notes / Reference	Beamesderfer et al. 1998, recent years from U.S. v Oregon T.A.C. spreadsheets from Henry Yuen
Age Notes / Reference	ODFW, used Grande Ronde River aggregate to fill in missing years
Population	Chamberlain Creek
Years of Data, Length of Series	1952 - 1997, 22 years
Abundance Type	Redds per mile
Hatchery Notes / Reference	Streamnet: trend 41052
Harvest Notes / Reference	
Age Notes / Reference	Keifer et al. 1992 (in Myers et al. 1998), used Middle Fork Salmon River age structure
Population	Grande Ronde River, Upper (Index area)
Years of Data, Length of Series	1960 - 2001, 42 years
Abundance Type	Redd count
Hatchery Notes / Reference	Streamnet (prior to 1997); Keniry 2002 (1997-2001) 12 ESU's data file, Eli Holmes, NWFSC
Harvest Notes / Reference	R. Carmichael, ODFW. 1/2003
Age Notes / Reference	ODFW, used Grande Ronde River aggregate to fill in missing years
Population	Herd Creek
Years of Data, Length of Series	1958 - 1986, 28 years
Abundance Type	Redds per mile
Hatchery Notes / Reference	Streamnet: trend 41018
Harvest Notes / Reference	
Age Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)*(Trib HR)* Used Valley Creek spring chinook age structure
Population	Innaha River
Years of Data, Length of Series	1953 - 2001, 49 years
Abundance Type	Expanded redd count
Hatchery Notes / Reference	Beamesderfer et al. 1998
Harvest Notes / Reference	Beamesderfer et al. 1998
Age Notes / Reference	R. Carmichael, ODFW. 1/2003

<u>Age Notes / Reference</u>	Beamesderfer et al. 1998
Population	Johnson Creek 1957 - 2001, 45 years Expanded redd count Beamesderfer et al. 1998
Abundance Type	Beamesderfer et al. 1998
Abundance Notes / Reference	
Hatchery Notes / Reference	
Harvest Notes / Reference	
<u>Age Notes / Reference</u>	CTC database from Tom G. IDFG, used South Fork aggregate data to fill in missing years
Population	Lake Creek summer-run 1952 - 2000, 49 years Redds per Mile Streamnet: 41059
Years of Data, Length of Series	
Abundance Type	
Abundance Notes / Reference	R.A.A.C. run reconstructions, EDT Validation. CD 1.
Hatchery Notes / Reference	R.A.A.C. run reconstructions, EDT Validation. CD 1. HR = 1-(1-Columbia HR)*(Trib HR)
Harvest Notes / Reference	
<u>Age Notes / Reference</u>	IDFG, used South Fork Salmon aggregate data to fill in missing years
Population	Lemhi River 1957 - 2001, 45 years Redd Count Elms-Cockstrom 1998, Kiefer 2002 (1999-2001)
Years of Data, Length of Series	
Abundance Type	
Abundance Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)*(Trib HR)
Hatchery Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)*(Trib HR)
Harvest Notes / Reference	
<u>Age Notes / Reference</u>	IDFG, used a weighted average to fill in missing years
Population	Lick Creek (Imnaha) 1964 - 2001, 38 years Redd count Adundance database reference #52 (prior to 1997), Keniry 2002 (1997-2001)
Years of Data, Length of Series	
Abundance Type	
Abundance Notes / Reference	Beamesderfer et al. 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Hatchery Notes / Reference	Beamesderfer et al. 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Harvest Notes / Reference	
<u>Age Notes / Reference</u>	Beamesderfer et al. 1998
Population	Lookingglass Creek 1957 - 2001, 44 years Redd count
Years of Data, Length of Series	
Abundance Type	

Abundance Notes / Reference	Streamnet 2000 (prior to 1997), Keniry 2002 (1997-2001)					
Hatchery Notes / Reference	12 ESU's data file, Eli Holmes, NWFSC					
Harvest Notes / Reference						
Age Notes / Reference	<u>ODFW, used Grande Ronde River aggregate to fill in missing years</u>					
Population	Loon Creek					
Years of Data, Length of Series	1957 - 2001, 43					
Abundance Type	Redd count					
Abundance Notes / Reference	Elms-Cockrom 1998, Kiefer 2002 (1999-2001)					
Hatchery Notes / Reference	No annual sampling, assumed natural returns					
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)					
Age Notes / Reference	Middle Fork <u>Salmon</u> River composite age structure data					
Population	Lostine River (Index Area)					
Years of Data, Length of Series	1964 - 2001, 38 years					
Abundance Type	Redd Count					
Abundance Notes / Reference	Abundance database reference #52, ODFW 1997, Keniry 2002 (1997-2001)					
Hatchery Notes / Reference	12 ESU's data file, Eli Holmes, NWFSC					
Harvest Notes / Reference	Beamesderfer et al 1998, recent years updated with U.S. v Oregon T.A.C. spreadsheet from Henry Yuen					
Age Notes / Reference	ODFW, used Grande Ronde River aggregate to fill in missing years					
Population	Marsh Creek					
Years of Data, Length of Series	1957 - 2001, 45 years					
Abundance Type	Total Live Count					
Abundance Notes / Reference	Beamesderfer et al. 1998					
Hatchery Notes / Reference	Marmorek and Peters 1998					
Harvest Notes / Reference	CTC database from Tom G.					
Age Notes / Reference	IDFG, used Middle Fork <u>Salmon</u> River composite to fill in missing years					
Population	Minam River					
Years of Data, Length of Series	1964 - 2001, 38 years					
Abundance Type	Total live count					
Abundance Notes / Reference	Beamesderfer et al. 1998					
Hatchery Notes / Reference	Marmorek and Peters 1998					
Harvest Notes / Reference	CTC database from Tom G.					
Age Notes / Reference	ODFW, used Grande Ronde River aggregate to fill in missing years					

Population	Pahsimeroi River
Years of Data, Length of Series	1980 - 2001, 22 years
Abundance Type	Total live count
Hatchery Notes / Reference	Streamnet 2002 (1980-2000), Rogers 2002 (2001)
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Age Notes / Reference	Used Lemhi River age structure
Population	Poverty Flat
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Total Live Count
Hatchery Notes / Reference	Beamesderfer et al 1998
Harvest Notes / Reference	Marmorek and Peters 1998
Age Notes / Reference	CTC database from Tom G. IDFG, used South Fork Salmon River aggregate to fill in missing years
Population	Rapid River (L. Salmon)
Years of Data, Length of Series	1972 - 2001, 30 years
Abundance Type	Redds per mile
Hatchery Notes / Reference	Streamnet 2002 (1972-2000), Rogers 2002 (2001)
Harvest Notes / Reference	
Age Notes / Reference	
Population	Salmon River, East Fork summer-run
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Redds per mile
Hatchery Notes / Reference	Streamnet: trend 41016
Harvest Notes / Reference	No annual sampling, assumed natural returns
Age Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR) Beamesderfer et al. 1998, used Poverty Flat summer-run
Population	Salmon River, South Fork summer-run
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Redd Count
Abundance Notes / Reference	Elms-Cockrom 1998, Kiefer 2002 (1999-2001)

Hatchery Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 1.
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 1. HR = 1-(1-Columbia HR)* (Trib HR)
Age Notes / Reference	IDFG
Population	Salmon R, North Fork spring-run
Years of Data, Length of Series	1960 - 2000, 27 years
Abundance Type	Redd Count
Abundance Notes / Reference	Streamnet, Brown 2002 (1996-2000)
Hatchery Notes / Reference	
Harvest Notes / Reference	
Age Notes / Reference	
Population	Salmon River, Upper spring-run
Years of Data, Length of Series	1954 - 2001, 48 years
Abundance Type	Redd Count
Abundance Notes / Reference	Elms-Cockrom 1998, Kiefer 2002 (1999-2001)
Hatchery Notes / Reference	
Harvest Notes / Reference	
Age Notes / Reference	
Population	Salmon River, Upper summer-run
Years of Data, Length of Series	1957 - 1997, 40 years
Abundance Type	Redds per mile
Abundance Notes / Reference	Streamnet: trend 41002
Hatchery Notes / Reference	
Harvest Notes / Reference	
Age Notes / Reference	
Population	Secesh River summer-run
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Redd count
Abundance Notes / Reference	Elms-Cockrom 1998, Kiefer 2002 (1999-2001)
Hatchery Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 1.
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 1. HR = 1-(1-Columbia HR)* (Trib HR)
Age Notes / Reference	IDFG, used South Fork Salmon aggregate to fill in missing years
Population	Snake River spring-run

Years of Data, Length of Series	1979 - 2001, 23 years
Abundance Type	Total live count
Hatchery Notes / Reference	Columbia River Basin Fish Management Plan Tech. Adv Comm. 2002: spreadsheets sent from Henry Yuen, USFWS
Harvest Notes / Reference	Columbia River Basin Fish Management Plan Tech. Adv Comm. 2002: spreadsheets sent from Henry Yuen, USFWS
Age Notes / Reference	Columbia River Basin Fish Management Plan Tech. Adv Comm. 2002: spreadsheets sent from Henry Yuen, USFWS Beamesderfer at al. 1998
Population	Snake River summer-run
Years of Data, Length of Series	1979 - 2002, 24 years
Abundance Type	Dam count
Hatchery Notes / Reference	CTC Report 2002
Harvest Notes / Reference	Columbia River Basin Fish Management Plan Tech. Adv Comm. 2002: spreadsheets sent from Henry Yuen, USFWS
Age Notes / Reference	CTC Report 2002 Beamesderfer at al. 1998
Population	Sulphur Cr
Years of Data, Length of Series	1957 - 2001, 45 years
Abundance Type	Total live count
Hatchery Notes / Reference	IDFG comments to NMFS, 2002
Harvest Notes / Reference	Beamesderfer at al. 1998
Age Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)*(Trib HR) IDFG, used Middle Fork Salmon River composite to fill in missing years
Population	Tucannon River
Years of Data, Length of Series	1979 - 2001, 23 years
Abundance Type	Total live count
Hatchery Notes / Reference	WDFW comments to NMFS, 2003.
Harvest Notes / Reference	WDFW comments to NMFS, 2003.
Age Notes / Reference	Columbia River Basin Fish Management Plan Tech. Adv Comm. 2002: spreadsheets sent from Henry Yuen, USFWS 1985-99 average and 2000 estimate of spring chinook age composition from WDFW Rep. Gallatin, J. P., J. Bumgarner, L. Ross and M. Varney. 2001. Tucannon River Spring Chinook

Salmon Hatchery Evaluation Program. 2000 annual rept. FPA01-05. 44p.

Population	Valley Creek, Upper spring-run
Years of Data, Length of Series	1957 - 2001, 44 years
Abundance Type	Redd count
Abundance Notes / Reference	Elms-Cockrom 1998, Kiefer 2002 (1999-2001)
Hatchery Notes / Reference	No annual sampling, assumed natural returns
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Age Notes / Reference	IDFG, used Salmon River aggregate to fill in missing years
Population	Valley Creek, Upper summer-run
Years of Data, Length of Series	1952 - 1997, 49 years
Abundance Type	Redds per mile
Abundance Notes / Reference	Streamnet: trend 41009
Hatchery Notes / Reference	
Harvest Notes / Reference	
Age Notes / Reference	
Population	Wallowa River
Years of Data, Length of Series	1963 - 2001, 39 years
Abundance Type	Redd count
Abundance Notes / Reference	52 , ODFW 1997, Keniry 2002 (1997-2001)
Hatchery Notes / Reference	R. Carmichael, ODFW. 1/2003
Harvest Notes / Reference	Beamesderfer et al 1998, recent years updated with U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Age Notes / Reference	Beamesderfer et al. 1998, used Grande Ronde age structure
Population	Wenaha River (Index Area)
Years of Data, Length of Series	1963 - 2001, 39 years
Abundance Type	Redd Count
Abundance Notes / Reference	52 , ODFW 1997, Keniry 2002 (1997-2001)
Hatchery Notes / Reference	12 ESU's data file, Eli Holmes, NWFSC (used South Fork Wenaha values)
Harvest Notes / Reference	Beamesderfer et al. 1998, recent years from U.S. v Oregon T.A.C. spreadsheet from Henry Yuen
Age Notes / Reference	Used pooled Grande Ronde River age structure values (Beamesderfer)
Population	Yankee Fork River summer-run
Years of Data, Length of Series	1960 - 2001, 42 years

Abundance Type	Redd Count
Abundance Notes / Reference	Streamnet (SN ref: Elms-Cockrum 1994-1997), Brown 2002 (1998-2001)
Hatchery Notes / Reference	No annual sampling; assumed natural returns
Harvest Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Age Notes / Reference	Beamesderfer et al. 1998, used Poverty Flat age structure
Population	Yankee Fork, West Fork spring-run
Years of Data, Length of Series	1960 - 2001, 41 years
Abundance Type	Redd Count
Abundance Notes / Reference	Streamnet, Brown 2002 (1998-2001)
Hatchery Notes / Reference	R.A.A.C. Run Reconstructions, EDT Validation. CD 2. HR = 1-(1-Columbia HR)* (Trib HR)
Harvest Notes / Reference	Keifer et al. 1992 (in Myers et al. 1998). used Salmon River age structure

Puget Sound Chinook Salmon ESU

Population	South Fork Nooksack River
Years of Data, Length of Series	1984-2001
Abundance Type	Carcass/redd
Abundance References	Pete Castle & Ned Currens, personal communication (2001a); Nooksack co-manager meeting (NMFS and Co-managers 2002)
Abundance Notes	Escapements are an expansion of carcass spawning surveys in the upper south fork and in Huchinson and Skookum creeks prior to 1999 and redd counts times 2.5 from 1999 on. They are designated early spawners; counts stop 1 October (fish after that thought to be out of basin strays)
Hatchery Reference	Pete Castle & Ned Currens (2001a); Nooksack co-manager meeting (NMFS and co-managers 2002)
Hatchery Notes	Contribution rate of hatchery fish to natural spawning only estimated since 1999 (carcass surveys looking for marked fish). It is assumed that the number of hatchery fish on spawning grounds is correlated with number of hatchery fish returning rather than number of fish on spawning grounds. Therefore, the stray rate of hatchery to spawning grounds for years without data is estimated as the average of the three years observed, not to exceed 43% of the spawning fish CTC Model and ER analyses output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Harvest Reference	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries
Harvest Notes	

and estimates incidental mortalities by the CTC) and of the natural mortality constants.

Maturation rates from CTC model run for Nooksack stock.

Age database (WDFW et al 2001a)

Scale sampling: n=226 fish sampled from 1993-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population	Cedar River	1965-2002	Live count surveys SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001) Escapement estimates are from live count surveys and expanded by area under the curve method SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001) There is no estimate of the contribution rate of hatchery fish to natural spawning CTC Model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source Age database (WDFW et al 2001a)	Age database (WDFW et al 2001a) Scale sampling: n=9 fish sampled in 1988. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)	Dosewallips River	1987-2002	Live/dead surveys and redd counts SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001) Three years reported no escapement; the TRT is using 1 fish each for those years (the surveyors could easily have missed one fish and it makes calculations easier) SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan:
Population								
Years of Data, Length of Series								
Abundance Type								
Abundance References								
Abundance Notes								
Hatchery Reference								
Hatchery Notes								
Harvest Reference								
Harvest Notes								

Hatchery Notes	Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001)						
Harvest Reference	Probably few if any hatchery strays into the Dosewallips.						
Harvest Notes	1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)						
	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.						
	Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source						
Age Reference	Age database (WDFW et al 2001a)						
Age Notes	n=9 fish sampled from 1995-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)						
Population	Dungeness River						
Years of Data, Length of Series	1986-2002						
Abundance Type							
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001)						
Abundance Notes	Escapements for Dungeness are for spring/summer stock with spawning from August to mid-Oct Washington State salmon and steelhead stock inventory and Appendix 1 Puget Sound Stocks (WDF et. al 1992)						
Hatchery Notes	There are no estimates of contribution rate of hatchery fish to natural spawners?						
Harvest Reference							
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.						
	Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source						
Age Reference	Age database (WDFW et al 2001a)						
Age Notes	Scale sampling, n=99 fish sampled from 1987-1998. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)						
Population	Elwha River						
Years of Data, Length of Series	1986-2002						
Abundance Type							

Abundance References

2001 Management Framework Plan and Salmon Runs' Status for the Strait of Juan de Fuca (WDFW et al 2001c); NMFS/Co-managers Meeting Point No Point (NMFS and Co-managers 2002)

Abundance Notes

Escapement to natural grounds equals total post fishery escapement minus broodstock take and rack return, and includes pre-spawning mortality

2001 Management Framework Plan and Salmon Runs' Status for the Strait of Juan de Fuca (WDFW et al 2001c); NMFS/Co-managers Meeting Point No Point (NMFS and Co-managers 2002)

Hatchery Notes

Harvest Reference

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age database (WDFW et al 2001a)

Scale sampling: n=2322 fish sampled from 1989-1998. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population	Green River
Years of Data, Length of Series	1968-2002
Abundance Type	Redd count
Abundance References	
SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Estimation of contribution of hatchery origin fall-run chinook salmon to Duwamish-Green River spawning ground populations (NWIFC 2001)	

Abundance Notes

Escapements for this population do not include spawning in Newaukum Creek. Escapement estimates are based on redd counts in specified sections of the river and expanded by a factor to reflect the total spawning habitat of the river.

Estimation of contribution of hatchery origin fall-run chinook salmon to Duwamish-Green River spawning ground populations (NWIFC 2001)
Hatchery contribution estimates from Soos, Icy, and Keta creeks hatcheries
CTC Model and ER analyses output (CTC 2000)

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.

Maturity rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age database (WDFW et al 2001a)

Scale sampling, n=2454 fish sampled from 1988-1998. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population

Lower Sauk River
1952-2002

Abundance Type

Redd count

Abundance References

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan:
Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Bob Hayman,
unpublished data. (Hayman 2002)

Abundance Notes

Hatchery Reference

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan:
Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Bob Hayman,
unpublished data (Hayman 2002)

Hatchery Notes

Harvest Reference

There is no estimate of the contribution rate of hatchery fish to natural spawning
CTC Model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical
Committee (CTC 1999); A User's Guide to the A&P Tables (Sands, in prep)

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.
Maturity rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age database (WDFW et al 2001a)

Scale sampling from Upper Skagit; n=1362 fish sampled from 1992-2000. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population

Lower Skagit River
1952-2002

Abundance Type

Redd count

Abundance References

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002)

Abundance Notes

Hatchery Reference

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002)

Hatchery Notes

Harvest Reference

Marblemount Hatchery rack returns.
CTC Model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999); A User's Guide to the A&P Tables (Sands, in prep)

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.
Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age Reference

Age Notes

Age database (WDFW et al 2001a)
Scale sampling, n=440 fish sampled from 1992-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population

Years of Data, Length of Series

Abundance Type

Abundance References

Nisqually River
1968-2002
Carcass
SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Jim Scott, pers.comm. (Scott 2002)

Abundance Notes

Hatchery Reference

Escapements are an expansion of spawning surveys in Prairie River/creek.
SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Jim Scott, pers.comm (Scott 2002)
No estimates of contribution of hatchery fish to natural spawning have been made in past, but will start in 2002
CTC ER and chinook model output (CTC 1999); Review of 2000 Ocean Salmon Fisheries (PFMC 2001)

Abundance References

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002)

Abundance Notes

Hatchery Reference

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002)

Hatchery Notes

Harvest Reference

Marblemount Hatchery rack returns.
CTC Model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999); A User's Guide to the A&P Tables (Sands, in prep)

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.
Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age Reference

Age Notes

Age database (WDFW et al 2001a)
Scale sampling, n=440 fish sampled from 1992-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population

Years of Data, Length of Series

Abundance Type

Abundance References

Nisqually River
1968-2002
Carcass
SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Jim Scott, pers.comm. (Scott 2002)

Abundance Notes

Hatchery Reference

Escapements are an expansion of spawning surveys in Prairie River/creek.
SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Jim Scott, pers.comm (Scott 2002)
No estimates of contribution of hatchery fish to natural spawning have been made in past, but will start in 2002
CTC ER and chinook model output (CTC 1999); Review of 2000 Ocean Salmon Fisheries (PFMC 2001)

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.

Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age database (WDFW et al 2001a)

Scale sampling from Upper Skagit; n=1362 fish sampled from 1992-2000. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population

Years of Data, Length of Series

Abundance Type

Abundance References

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan:
Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Jim Scott, pers
comm (Scott 2002); Pete Castle and Ned Currens pers comm, memo “North Fork Nooksack
native spring chinook escapement methodology” (Castle and Currens 2001a,b)
Total chinook on the spawning grounds = expanded carcass counts on spawning grounds plus
turnback hatchery fish.

Hatchery Reference

SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan:
Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Jim Scott, pers
comm (Scott 2002); Pete Castle and Ned Currens pers comm, memo “North Fork Nooksack
native spring chinook escapement methodology” (Castle and Currens 2001a,b)
Contribution rate of cultured fish (hatchery and acclimation releases) to natural spawning started
in 1988 with significant returns from the hatchery program.

Harvest Reference

CTC model and ER analyses output (CTC 2000) 1995 and 1996 annual report of the Joint
Chinook Technical Committee (CTC 1999)

Harvest Notes

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.

Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age database (WDFW et al 2001a)

Scale sampling, n=359 fish sampled from 1992-2000. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands).

Population	Lake Washington tributaries
Years of Data, Length of Series	1983-2002
Abundance Type	Live counts
Abundance References	SaSI database (Campbell 2000); NMFS/Co-manager meeting on abundance and productivity data (NMFS and Co-managers 2002)
Abundance Notes	Escapement estimates are from live counts expanded for area under the curve.
Hatchery Reference	SaSI database (Campbell 2000); NMFS/Co-manager meeting on abundance and productivity data (NMFS and Co-managers 2002)
Hatchery Notes	No estimate of contribution rate of hatchery fish to spawning. There are trapping data that indicate the presence of hatchery strays.
Harvest Reference	CTC model and ER analyses output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.
Age Reference	Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Age Notes	Age database (WDFW et al 2001a)
	Scale sampling, n=82 fish sampled in 1985 and 1988. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands).
Population	North Fork Stillaguamish River
Years of Data, Length of Series	1974-2002
Abundance Type	Redd count
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, pers comm. (Rawson and Kraemer); Jim Scott, pers comm (Scott 2002)
Abundance Notes	Escapement estimates are from foot and boat surveys of the mainstem and foot surveys of the tributaries of redd counts.
Hatchery Reference	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Indian Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, pers comm. (Rawson and Kraemer); Jim Scott, pers comm (Scott 2002)
Hatchery Notes	Stillaguamish Tribal Harvey Creek Hatchery, supplementation program, does not have rack

Harvest Reference	CTC Model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source Age database (WDFW et al 2001a)
Harvest Notes	Otolith project; n=2840 fish sampled from 1987 and 1988-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)	
Population	Puyallup River	
Years of Data, Length of Series	1968-2002	
Abundance Type	Redd and live/dead fish count	
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); 1992 Washington State salmon and steelhead stock inventory (WDF et al 1993); Jim Scott, pers comm (Scott 2002)	
Abundance Notes	Index counts of spawning from South Prairie Creek, which in the past were from a limited area and not a good index of the system. Surveys now are from the entire S. Prairie Creek basin. These started in 1992 by float and foot surveys of redds and live/dead fish. However, estimates given here are based on index count only through 1998. Revisions are being made back to 1992 and should be available soon.	
Hatchery Reference	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); 1992 Washington State salmon and steelhead stock inventory (WDF et al 1993); Jim Scott, pers comm (Scott 2002)	
Hatchery Notes	There is no estimate of the contribution rate of hatchery fish to natural spawning	
Harvest Reference	CTC ER and chinook model output for fishing rates and new runs with fingerling releases (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)	
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis	

may be used as an alternative data source

Age database (WDFW et al 2001a)

Scale sampling; n=930 fish sampled from 1992-2000. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years
(Norma Sands)

Population	Skokomish River
Years of Data, Length of Series	1987-2002
Abundance Type	Various
Abundance References	Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Washington State salmon and steelhead stock inventory and Appendix 1 Puget Sound Stocks (WDF 1993); NMFS/comanager meeting, Point No Point (NMFS and Comanagers 2002)
Abundance Notes	Escapements are from the Comanagers management report. Estimates should be available from 1976 although there is concern about data prior to 1990 (T. Johnson) (see NWIFC website). This population includes index survey sites in both main river including NF and several tributaries; mainly foot, sometimes float. Escapement estimates vary from year to year in survey type and expansion (from 1990 on no expansion for unsurvey areas - in other words all spawning areas are surveyed). Quality of escapement data considered good (SASSI document)
Hatchery Reference	Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Washington State salmon and steelhead stock inventory and Appendix 1 Puget Sound Stocks (WDF 1993); NMFS/comanager meeting, Point No Point (NMFS and Comanagers 2002)
Hatchery Notes	Hatchery strays from the George Adams H, HoodCanal (Hoodsport H, and Ehetai H) are found on the spawning grounds, but there is no estimate of the contribution rate of hatchery fish to natural spawning
Harvest Reference	1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Age Reference	Age database (WDFW et al 2001a)
Age Notes	Scale sampling; n=1 fish sampled in 2001. Age distribution reconstructed for other years using

average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Population	Skykomish River	
Years of Data, Length of Series	1965-2002	Aerial surveys, redd count
Abundance Type		SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan; Harvest Management Component (Puget Sound Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, otolith sampling on spawning grounds (Rawson and Kraemer 2001)
Abundance Notes		Escapements for the Skykomish population have been updated from the comanagers (Curt Kraemer & Kit Rawson 1/9/02) for 1979-2001. The Skykomish population includes 10 survey sites in the Skykomish, Wallace, Bridal Veil, Sunset Falls, Pilchuck, and Sultan rivers. Escapement estimates are from aerial surveys of the mainstem and foot surveys of the tributaries (redd counts). Escapement estimates for the total Snohomish system are available from 1965. Skykomish estimates for 1965-1978 are made by subtracting Skykomish population escapements from the total system escapements
Hatchery Reference		SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan; Harvest Management Component (Puget Sound Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, otolith sampling on spawning grounds (Rawson and Kraemer 2001)
Hatchery Notes		From 1997 to the present, contribution rate of hatchery fish to natural spawning is estimated by sampling spawning grounds for otolith marked hatchery fish from Tulalip and Wallace Hatcheries. Prior to 1997, the hatchery contribution is estimated from "run reconstruction" of hatchery returns (Kit Rawson 11/19/01).
Harvest Reference		CTC ER and model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999); Terminal Harvest Rates for Snohomish R. Using Terminal Run Reconstruction (Rawson 2001)
Harvest Notes		Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Age Reference		Kit Rawson and Curt Kraemer, otolith sampling on spawning grounds (Rawson and Kraemer 2001); Age database (WDFW et al 2001a)
Age Notes		Scale or otolith sampling; n=561 fish sampled from 1989-1999, except years 1990 and 1994. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands).

Population	Snoqualmie River
Years of Data, Length of Series	1965-2002
Abundance Type	From hatchery straying estimates and otolith sampling
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, otolith sampling on spawning grounds (Rawson and Kraemer 2001)
Abundance Notes	Escapements for the Snoqualmie population have been updated from the comanagers (Curt Kraemer & Kit Rawson 11/19/01 7 1/9/02) for 1979-2000. The Snoqualmie population includes 6 survey sites in the Snoqualmie River and tributaries of the Snoqualmie R. Escapement for the SaSSI Snohomish fall-run stock are available from 1965 (Jim Scott spreadsheet) and, on average, the Snoqualmie portion represented 62% of the Snohomish fall-run escapement. Thus, estimates of Snoqualmie escapement prior to 1979 are estimated as 62% of the Snohomish fall-run escapement.
Hatchery Reference	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, otolith sampling on spawning grounds (Rawson and Kraemer 2001)
Hatchery Notes	From 1997 to the present, contribution rate of hatchery fish to natural spawning is estimated by sampling spawning grounds for otolith marked hatchery fish from Tulalip and Wallace Hatcheries. Prior to 1997, the hatchery contribution is estimated from "run reconstruction" of hatchery returns (Kit Rawson 11/19/01).
Harvest Reference	CTC ER and model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999); Terminal Harvest Rates for Snohomish R. Using Terminal Run Reconstruction (Rawson 2001)
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Age Reference	Kit Rawson and Curt Kraemer, otolith sampling on spawning grounds (Rawson and Kraemer 2001); Age database (WDFW et al 2001a)
Age Notes	Scale sampling and scale/otolith sampling; n=572 fish sampled from 1989 and 1992-1999. Age distribution reconstructed for other years using average cohort distribution weighted by annual

abundance of contributing years (Norma Sands)

Population	South Fork Stillaguamish River
Years of Data, Length of Series	1974-2002
Abundance Type	redd count
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, pers comm. (Rawson and Kraemer); Jim Scott, pers comm. (Scott 2002)
Abundance Notes	Escapement estimates are from foot and boat surveys of the mainstem and foot surveys of the tributaries of redd counts
Hatchery Reference	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Kit Rawson and Curt Kraemer, pers comm. (Rawson and Kraemer); Jim Scott, pers comm. (Scott 2002)
Hatchery Notes	It is assumed that no hatchery fish stray to the spawning grounds of the South Fork Stillaguamish CTC Model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.
Harvest Reference	Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Age Reference	Age database (WDFW et al 2001a)
Age Notes	Otholith project; n=1641 fish sampled from 1987 and 1989-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)
Population	Suquamish River
Years of Data, Length of Series	1952-2002
Abundance Type	Redd count; peak live/dead counts
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002)
Abundance Notes	Before 1994 esc method was peak live/dead counts for partial spawning grounds to get fish per

	<p>mile and then expand for total spawning grounds (by 8.5). 1994 and after use redd counts cover entire spawning area</p> <p>SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002)</p> <p>No hatchery in basin; broodstock take from the Suiattle 1974-1988 to the Marblemount Hatchery (and fry released at Hatchery)</p>
Hatchery Reference	CTC CWT ER and model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Hatchery Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Harvest Reference	Age database (WDFW et al 2001a)
Harvest Notes	Scale sampling, n=672 fish sampled from 1986-1990 and 1992-2001. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)
Population	Upper Cascade River
Years of Data, Length of Series	1984-2002
Abundance Type	Live/dead counts expanded for area/redd count
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002); NMFS/Comanagers meeting (NMFS and Comanagers 2002)
Abundance Notes	Before 1992 esc method was peak live/dead counts with expansion for uncovered ground. 1992 and after use redd counts cover entire spawning area
Hatchery Reference	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002); NMFS/Comanagers meeting (NMFS and Comanagers 2002)
Hatchery Notes	The hatchery is at the mouth of the Cascade, but releases fish into the Suiattle.

Harvest Reference	CTC CWT ER and model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source Age database (WDFW et al 2001a) Scale sampling, n=157 fish sampled from 1992-1998 and 2000-2001. Age distribution reconstructed for other years using an average cohort distribution weighted by the annual abundance of contributing years (Norma Sands)
Age Reference	
Age Notes	
Population	Upper Sauk River
Years of Data, Length of Series	1952-2002
Abundance Type	Redd count; peak live/dead
Abundance References	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002)
Abundance Notes	Before 1994 escapement estimation method was peak live/dead counts with expansion for uncovered ground. 1994 and after use redd counts and cover entire spawning area
Hatchery Reference	
Hatchery Notes	No hatchery in Upper Sauk. Assume the hatchery releases from the Marblemount Hatchery do not influence the Sauk populations
Harvest Reference	CTC CWT ER and model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)
Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source Age database (WDFW et al 2001a) Scale sampling, n=349 fish sampled from 1986, 1992-1995, 1997-2001. Age distribution reconstructed for other years using an average cohort distribution weighted by the annual

abundance of contributing years (Norma Sands)

Population	Upper Skagit River 1952-2002	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002)
Abundance Type	Redd count	Escapements are based on redd counts and are considered a good measure of relative abundance from year to year
Abundance References	Hatchery Reference	SaSI database (Campbell 2000); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW 2001); Bob Hayman, unpublished data (Hayman 2002); Jim Scott, pers comm (Scott 2002)
Abundance Notes	Hatchery Notes	Marblemount Hatchery rack returns. The Marblemount Hatchery is situated at the mouth of the Cascade River, such that returns pass through the Lower and Upper Skagit River
	Harvest Reference	CTC model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999); A User's Guide to the A&P Tables (Sands, in prep)
	Harvest Notes	Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants.
		Maturity rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source
Age Reference	Age database (WDFW et al 2001a)	Age sampling, n=1731 fish sampled from 1992-2001. Age distribution reconstructed for other years using an average cohort distribution weighted by the annual abundance of contributing years (Norma Sands)
Age Notes	White River 1970-2002	1992 Washington State salmon and steelhead stock inventory (WDFW et al 1993); SaSI database (Campbell 2000); Chris Phinney, pers comm (Phinney 2001); Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (Puget Sound Tribes and WDFW

2001); Jim Scott, pers comm (Scott 2002)
Chinook counts from 1970-present are from Buckley trap for the entire season (year round). Does not include any spawning that occurs below the dam which may represent about 25% of total spawning (11/21/02). Glacial system, thus spawning ground surveys difficult. Starting this year rejecting (not passing upstream) tagged or marked fish (except acclimated fish). Earlier years may include fall-run hatchery fish.

Hatchery Reference

Hatchery Notes

There is a program to put acclimated hatchery fish on the spawning grounds, will begin to estimate this. No estimates of hatchery contribution prior to 2001. Assume no contribution of hatchery fish to natural spawning

Harvest Reference

Harvest Notes

CTC ER and model output (CTC 2000); 1995 and 1996 annual report of the Joint Chinook Technical Committee (CTC 1999)

Fishing rates are a function of catch and escapement estimates (usually based on CWT recoveries and estimates incidental mortalities by the CTC) and of the natural mortality constants. Maturation rates are calculated from age data, but independent estimates from CWT analysis may be used as an alternative data source

Age Reference

Age Notes

Age database (WDFW et al 2001a)
Scale sampling, n=1335 fish sampled from 1990, 1993-1998. Age distribution reconstructed for other years using average cohort distribution weighted by annual abundance of contributing years (Norma Sands)

Lower Columbia River chinook salmon ESU

Population

Big White Salmon River fall-run
Years of Data, Length of Series
1964 - 2000, 37 years

Abundance Type

Peak Count

Rawding, Dan (WDFW). 2001a; Norman, G. 1982.

Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate. 1980-2000 data from Rawding. 1964-1979 data from streamnet reference (Norman)

Hatchery Reference

Hatchery Notes

Hatchery data are part of the escapement data from Dan Rawding, WDFW.

Harvest Reference Stock	Spring Creek
Harvest Reference	Pacific Salmon Commission 2002
Harvest Notes	Estimated exploitation rate on hatchery stocks applied to natural stocks.
Age Reference	Rawding, Dan (WDFW). 2001a.
Age Notes	Age distribution for 1982-1990 based on an average of 1991-2000.
Population	Clackamas River fall-run
Years of Data, Length of Series	1967 - 2001, 35 years
Abundance Type	Peak Count
Abundance References	ODFW 1998.
Hatchery Reference	No Hatchery Data
Hatchery Notes	No Hatchery Data
Harvest Reference	No Harvest Data Available
Age Reference	Myers, et al.1998.
Age Notes	Generic fall-run age structure
Population	Coweeaman River fall-run
Years of Data, Length of Series	1964 - 2000, 37 years
Abundance Type	Peak Count
Abundance References	Rawding, Dan (WDFW). 2001a; Kreitman, G.. 1981.
Abundance Notes	Abundance data are for adults and jacks. Estimates extrapolated from peak count data and marking rate. 1964-1979 spawning data from Kreitman; 1980-2000 from Rawding.
Hatchery Reference	Rawding, Dan (WDFW). 2001a.
Hatchery Notes	Hatchery data are part of the escapement data from Dan Rawding, WDFW.
Harvest Reference Stock	Coweeaman
Harvest Reference	Pacific Salmon Commission 2002.
Harvest Notes	Harvest data based on PFMC models provided by Dell Simmons.
Age Reference	Rawding, Dan (WDFW). 2001a.
Age Notes	Age distribution for 1980-1990 and estimate based on average from 1991-2000
Population	East Fork Lewis River fall-run
Years of Data, Length of Series	1980 - 2000, 21 years

Abundance Type	Peak Count
Abundance References	Rawding, Dan (WDFW). 2001a.
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate.
Hatchery Reference	Rawding, Dan (WDFW). 2001a.
Harvest Reference Stock	Lewis Wild
Harvest Reference	Rawding, Dan (WDFW). 2001a.
Harvest Notes	AEQ ER for Lewis River from Dell Simmons
Age Reference	Rawding, Dan (WDFW). 2001a.
Age Notes	Age distribution for 1980-1983 based on an average of 1984-2000
Population	Lewis River (Brights) fall-run
Years of Data, Length of Series	1964 - 2000, 37 years
Abundance Type	Peak Count
Abundance References	Rawding, Dan (WDFW). 2001a. Kreitman, G.. 1981.
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate. 1964-1979 spawning data from Kreitman; 1980-2000 from Rawding.
Hatchery Reference	Rawding, Dan (WDFW). 2001a.
Hatchery Notes	Hatchery data are part of the escapement data from Dan Rawding, WDFW.
Harvest Reference Stock	Lewis Wild
Harvest Reference	Pacific Salmon Commission. 2002.
Harvest Notes	AEQ provided by Dell Simmons
Age Reference	Rawding, Dan (WDFW).2001a.
Age Notes	Age distribution for 1980-1990 and estimate based on average from 1991-2000
Population	Middle Gorge Tributaries fall-run
Years of Data, Length of Series	1964 - 2000, 37 years
Abundance Type	Peak Count
Abundance References	Rawding, Dan (WDFW). 2001a; Norman, G. 1982.
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate. 1980-2000 data from Rawding. 1964-1979 data

from streamnet reference (Norman)

Hatchery Reference
Hatchery Notes
Harvest Reference
Age Reference
Age Notes

Rawding, Dan (WDFW). 2001a.

Hatchery data are part of the escapement data from Dan Rawding, WDFW.

No Harvest Data Available

Rawding, Dan (WDFW). 2001a.

Age distribution for 1980-1990 and estimate based on average from 1991-2000. Age distribution data missing for 1993

Population

Years of Data, Length of Series

Abundance Type

Abundance References

Abundance Notes

Hatchery Reference

Harvest Reference Stock

Harvest Reference

Age Reference

Age Notes

Mill Creek fall-run

1980 - 2000, 21 years

Peak Count

Rawding, Dan (WDFW). 2001a.

Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate.

Rawding, Dan (WDFW). 2001a.

Hatchery data are part of the escapement data from Dan Rawding, WDFW.

Coweeman

Pacific Salmon Commission. 2002

Rawding, Dan (WDFW). 2001a.

Age distribution for 1982-1990 based on an average of 1991-2000.

Population

Years of Data, Length of Series

Abundance Type

Abundance References

Abundance Notes

Sandy River fall-run

1988 - 2001, 14 years

Total from redd count

ODFW 1998

The estimate of spawning abundance is based on a one time peak count of live fish on the Sandy River. The index area is 10 miles from the mouth of Gordon Cr. To Lewis & Clark ramp. The number of fish is then multiplied by 2.5 to get the estimate (Streamnet ref # 50070). Fish counts are provided in Streamnet trend # 57517. Surveys were not conducted prior to 1988 ODFW 1998.

Hatchery Reference

Hatchery Notes

Harvest Reference

Age Reference

Michelle McClure (NOAA Fisheries) references ODFW for proportion of natural spawners

No Harvest Data Available

Meyers et al. 1998.

Age Notes	Generic fall-run age structure
Population	Sandy River late fall-run
Years of Data, Length of Series	1984 - 2001, 18 years
Abundance Type	Total from redd count
Abundance References	ODFW 2002; ODFW 1990; Murtagh, T.; Massey, J.; Bennett, D.E. 1997.
Hatchery Reference	ODFW 1998
Hatchery Notes	Michelle McClure (NOAA Fisheries) references ODFW for proportion of natural spawners
Harvest Reference	No Harvest Data Available.
Age Reference	Myers et al. 1998.
Age Notes	Generic fall-run age structure
Population	Washougal River fall-run
Years of Data, Length of Series	1964 - 2000, 37 years
Abundance Type	Peak Count
Abundance References	Rawding, Dan (WDFW). 2001a; Kreitman, G. 1981.
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate. 1964-1979 spawning data from Kreitman; 1980-2000 from Rawding.
Hatchery Reference	Rawding, Dan (WDFW). 2001a.
Hatchery Notes	Hatchery data are part of the escapement data from Dan Rawding, WDFW.
Harvest Reference Stock	Cowlitz Hatchery
Harvest Reference	Pacific Salmon Commission 2002.
Harvest Notes	AEQ provided by Dell Simmons
Age Reference	Rawding, Dan (WDFW). 2001a.
Age Notes	Age distribution for 1982-1990 based on an average of 1991-2000.
Population	Kalama River spring-run
Years of Data, Length of Series	1980 - 1999, 20 years
Abundance Type	Peak Count
Abundance References	Rawding, Dan (WDFW). 2001a.
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate.

Hatchery Reference	Rawding, Dan (WDFW). 2001a.		
Hatchery Notes	Hatchery data are part of the escapement data from Dan Rawding, WDFW.		
Harvest Reference	No Harvest Data Available.		
Age Reference	No Age Data Available.		
Population	Lewis River spring-run		
Years of Data, Length of Series	1980 - 1999, 20 years		
Abundance Type	Peak Count		
Abundance References	Rawding, Dan (WDFW). 2001a.		
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate.		
Hatchery Reference	Rawding, Dan (WDFW). 2001a.		
Hatchery Notes	Hatchery data are part of the escapement data from Dan Rawding, WDFW.		
Harvest Reference	No Harvest Data Available.		
Age Reference	No Age Data Available.		
Population	Upper Cowlitz River spring-run		
Years of Data, Length of Series	1980 - 1999, 20 years		
Abundance Type	Peak Count		
Abundance References	Rawding, Dan (WDFW). 2001a.		
Abundance Notes	Abundance data are for adults and jacks. Estimates of spawner abundance are extrapolations made using peak count data and marking rate.		
Hatchery Reference	Rawding, Dan (WDFW). 2001a.		
Hatchery Notes	Hatchery data are part of the escapement data from Dan Rawding, WDFW.		
Harvest Reference	No Harvest Data Available.		
Age Reference	Myers, et al. 1998.		
Population	Youngs Bay fall-run		
Years of Data, Length of Series	1950 - 2001, 52 years		
Abundance Type	Fish/Mile		
Abundance References	Fulop 2002, 2003		
Population	Big Creek fall-run		

Years of Data, Length of Series	1970 - 2001, 32 years
Abundance Type	Fish/Mile
Abundance References	Fulop 2003
Population	Clatskanie River fall-run

Years of Data, Length of Series	1970 - 2001, 32 years
Abundance Type	Fish/Mile
Abundance References	Fulop 2003

Upper Willamette River Chinook Salmon ESU

Population	Clackamas River spring-run
Years of Data, Length of Series	1958 - 2002, 45 years
Abundance Type	Dam/weir count
Abundance References	Cramer, Doug. 2002e.
Abundance Notes	Data are dam counts for NF Dam; adults only, production is mixed
Hatchery Reference	Cramer, Doug. 2002e.
Hatchery Notes	Counts of hatchery vs wild done only for 2001-2002 (Doug Cramer). Doug Cramer estimates the number of marked hatchery fish to be 50%.
Harvest Reference	No Harvest Data Available.
Age Reference	McClure, Michelle. 2002.
Age Notes	Age distribution is taken from the Upper Willamette Chinook totals, not specific to Clackamas R Spring-run Chinook.

Population	Mckenzie River spring-run
Years of Data, Length of Series	1970 - 2001, 32 years
Abundance Type	Dam/weir count
Abundance References	Kostow, Kathryn (ODFW). 2002b.
Abundance Notes	Data come from dam counts at Leaburg Dam. Spawning also occurs below the dam.
Hatchery Reference	Kostow, Kathryn (ODFW). 2002b.
Hatchery Notes	Hatchery fish have only been 100% marked in recent years. The hatchery marks are not 100% detectable at the dam because a portion of the hatchery fish is double index marked to evaluate the fishery impact to wild fish. Double index marks mean that the hatchery fish has a coded wire tag but it is not externally marked (that is, no fin clip). Therefore, the fish "looks wild" both

to the fisherman (who must release the fish) and in the raw dam count. The McKenzie fish managers therefore do several expansions to deal with these issues.

Harvest Reference	No Harvest Data Available.
Age Reference	McClure, Michelle. 2002.
Age Notes	Age distribution is taken from the Upper Willamette Chinook totals, not specific to McKenzie R Spring-run Chinook.

Population	Sandy River spring-run
Years of Data, Length of Series	1977 - 2001, 25 years
Abundance Type	Dam/weir count
Abundance References	Cramer, Doug. 2002d.
Abundance Notes	Abundance estimates only
Hatchery Reference	No Hatchery Data.
Harvest Reference	No Harvest Data Available.
Age Reference	No Age Data Available.
Population	Willamette Falls fall-run
Years of Data, Length of Series	1946 - 2001, 56 years
Abundance Type	Dam/weir count
Abundance References	Howell, P.J.. 1986; Bennett, D.E. and C.A. Foster. 1990; Bennett, D.E. and Foster, C.A.. 1994; Bennett, D.E. and C.A. Foster. 1995; Foster, C.A. 1998.
Abundance Notes	2 additional references: Foster 2000 and Foster 2002. Data are for adults and jacks.
Population	Willamette Falls spring-run
Years of Data, Length of Series	1946 - 2001, 56 years
Abundance Type	Dam/weir count
Abundance References	Anonymous. 1998; Foster, C.A. 1998; Foster, C.A. 2000.
Abundance Notes	Data are for adults and jacks.

Appendix A.5.3. Lower Columbia River hatchery releases.

Lower Columbia River fall-run chinook salmon (Washington)					
Watershed	Years	Hatchery	Stock	Release Site	Total
Chinook River	1990-1994	Sea Resources	Chinook River	Chinook River	2,598,400
	1990	Sea Resources	Washougal	Chinook River	629,500
	1997-2000	Sea Resources	Chinook River	Chinook River	820,627
	1993	Lower Columbia	Kalama Falls	Deep River	49,400
	1990-1994	Grays River	Grays River	Grays River	2,767,900
	1991, 1993	Grays River	Kalama Falls	Grays River	1,332,380
	1992	Grays River	Spring Creek	Grays River	1,107,000
	1995-1997	Grays River	Kalama	Grays River	764,550
	1996, 1997	Grays River	Washougal	Grays River	1,745,500
	1990-1994	Elokomin	Elochomin	Elochomin River	17,809,719
Elochomin River	1991	Elokomin	Kalama Falls	Elochomin River	1,046,700
	1995	Beaver Creek	Abernathy	Beaver Creek	377,252
	1997	Beaver Creek	Big Creek	Beaver Creek	1,096,198
	1996-1999	Beaver Creek	Elochoman	Elochoman River	2,081,670
	1995	Beaver Creek	Kalama	Beaver Creek	760,039
	1995-2001	Elochoman	Elochoman	Elochoman River	15,280,038
	1999	Elochoman	Grays River	Elochoman River	174,500
	1997-1998	Elochoman	Washougal	Elochoman River	1,633,200
	1996-1998	Cathlamet Fta	Washougal	Columbia River	1,132,500
	1990-1994	Cowlitz	Cowlitz	Cowlitz River	28,757,600
Cowlitz River	1995-2001	Cowlitz	Cowlitz	Cowlitz River	42,322,920
	1990-1993	Toutle	Kalama Falls	Green River	5,718,000
	1991-1993	Toutle	Toutle	Green River	2,941,000
	1994	Toutle	Tule	Green River	2,044,500
	1990-1993	Toutle	Washougal	Green River	2,693,400
	2000	North Toutle	Elochoman	Green River	618,266
	1996	North Toutle	Kalama	Green River	1,588,937
	1996-2001	North Toutle	Toutle	Green River	10,584,543
	1996	North Toutle	Washougal	Green River	633,414
	1991-1994	Lower Kalama	Kalama	Kalama River	10,701,203
Kalama River	1990-1994	Kalama Falls	Kalama Falls	Kalama River	17,600,800
	1996-2001	Fallert Cr	Kalama	Fallert Creek	13,998,602

	1995-2001	Kalama Falls	Kalama	Kalama River	20,198,653
	1994	Washougal	Kalama Falls	Washougal River	2,443,100
	1992	Washougal	Spring Creek	Washougal River	1,409,300
Washougal River	1991-1994	Washougal	Washougal	Washougal River	27,002,103
	2000	Washougal	Elochoman	Washougal River	1,312,680
	1995-2001	Washougal	Washougal	Washougal River	32,878,694
Spring Creek	1992	Ringold	L White Salmon	Spring Creek	82,511

Lower Columbia River fall-run chinook salmon (Oregon)

Watershed	Years	Hatchery	Stock	Release Site	Total
	1991-1995	Astoria H.S.	Big Creek	Youngs Bay	15,500
	1991-1994	Cedc	Rogue River	Youngs Bay	394,382
	1991, 1992	Step	Big Creek	Youngs Bay	13,758
	1992, 1993	Step	Klaskanine	Youngs Bay	15,700
	1996-1998	Step	Big Creek	Youngs Bay	63,050
	1997, 1998	Step	Unknown	Youngs Bay	16,500
	1995-2002	Youngs Bay	Rogue River	Youngs Bay	4,248,147
	1996-1998	Youngs Bay	Urb	Youngs Bay	828,884
	1991	Step	Unknown	Lower Columbia River	25,000
Lower Columbia River	1996, 1997	Tongue Pt	Rogue River	Tongue Point	54,274
	1996, 1997	Tongue Pt	Urb	Tongue Point	299,715
	1995-1997	Blind Slough	Rogue River	Blind Slough	54,793
	1992-1993	Step	Klaskanine	Skipanon River	3,550
Skipanon River	1996-1999	Step	Big Creek	Skipanon River	15,193
Plympton Creek	1991	Big Creek	Big Creek	Plympton Creek	50,278
	1991-1994	Big Creek	Big Creek	Big Creek	34,675,446
	1991-1994	Big Creek	Rogue River	Big Creek	2,798,710
Big Creek	1993	Big Creek	Kalama Falls	Big Creek	886,471
	1995-2002	Big Creek	Big Creek	Big Creek	40,633,091
	1995-1996	Big Creek	Rogue River	Big Creek	1,530,550
Klaskanine River	1995	Cedc	Rogue River	Klaskanine River	15,758
	1996-1999	Klaskanine	Rogue River	Klaskanine River	3,694,245
Wahkeena Pond	1991-1993	Bonneville	Urb	Columbia River	1,183,764
Johnson Creek	1994, 1995	Step	Tanner Creek	Johnson Creek	99,008
	1991	Bonneville	Big Creek	Tanner Creek	2,580,763
Tanner Creek	1991-1994	Bonneville	Tanner Creek	Tanner Creek	32,862,338

	1991	Bonneville	Wa Tule	Tanner Creek	1,534,122
	1991-1994	Bonneville	Urb	Tanner Creek	26,877,822
	1993	Bonneville	Kalama Falls	Tanner Creek	1,505,421
	1995-1996	Bonneville	Tanner Creek	Tanner Creek	15,369,642
	1995-1996	Bonneville	Wa Tule	Tanner Creek	10,922,745
	1995-2002	Bonneville	Urb	Tanner Creek	43,729,497
	2000-2001	Bonneville	Wa Urb	Tanner Creek	328,426

Lower Columbia River spring-run chinook salmon (Washington)

Watershed	Years	Hatchery	Stock	Release Site	Total
Deep River	1999-2001	Deep River	Cowlitz	Deep Creek	255,657
Abernathy Creek	1991-1996	Abernathy NFH	Abernathy Creek	Abernathy Creek	6,853,504
	1997-1999	Abernathy NFH	Abernathy Creek	Abernathy Creek	1,223,647
	1990-1994	Cowlitz	Cowlitz	Cowlitz River	9,016,451
	1992-1994	Friends Of Cow	Cowlitz	Cowlitz River	115,800
	1995-2001	Cowlitz	Cowlitz	Cowlitz River	8,870,002
Cowlitz River	1995,1997	Cowlitz	Cowlitz	Tilton River	3,074 Adults
	1996,1999	Friends Of Cowlitz	Cowlitz	Cowlitz River	53,800
	1991,1993	Toutle	Cowlitz	Green River	641,382
Toutle River	1995	North Toutle	Toutle	Green River	1,412,100
	1995	North Toutle	Washougal	Green River	1,086,100
	1995-2001	North Toutle	Cowlitz	Green River	766,740
	1990-1993	Speelyai	Lewis	Lewis River	1,229,262
	1994	Lewis River	Kalama	North Fork Lewis River	975,700
	1991,1992	Lewis River	Lewis	Lewis River	1,885,900
	1990-1994	Lewis River	N F Lewis	North Fork Lewis River	1,801,800
Lewis River	1996	Fish First Np	Lewis	Lewis River	55,872
	1997-2000	Fish First Np	Lewis	Lewis River	570,857
	1996,1998	Lewis River	Lewis	Lewis River	2,074,841
	2001	Lewis River	Lewis	Lewis River	34 Adults
	1995-2001	Lewis River	Lewis	Lewis River	4,692,781
	2001	Speelyai	Lewis	Lewis River	566,373
Kalama River	1990-1994	Lower Kalama	Kalama	Hatchery Creek	2,455,252
	1995-2001	Fallert Cr	Kalama	Fallert Creek	2,129,550
	1998,2000	Fallert Cr	Lewis	Fallert Creek	615,463
	1999	Gobar Pond	Kalama	Gobar Creek	87,500

		1997, 2001	Kalama Falls	Kalama	Gobar Creek	332,281
	1993	Ringold	Carson	Spring Creek	68,900	
	1993	Ringold	Kalama	Spring Creek	462,700	
	1990	Ringold	Klickitat	Spring Creek	40,264	
Spring Creek	1994	Ringold	L. White Salmon	Spring Creek	336,268	
	1993-1994	Ringold	Ringold	Spring Creek	596,274	
	1992-1994	Ringold	Wind River	Spring Creek	2,250,000	
Wind River	1991-1996	Carson NFH	Carson	Wind River	13,350,658	
	1997-2001	Carson NFH	Carson	Wind River	7,096,346	
	1991-1994	Little White Salmon NFH	Spring Creek	Little White Salmon River	2,757,539	
Little White Salmon River	1992	Willard NFH	Carson	Little White Salmon River	869,952	
	1991-1994	Little White Salmon NFH	Carson	Little White Salmon River	4,780,148	
	1997	Little White Salmon NFH	Carson	Little White Salmon River	2,835,741	
	1998-2001	Little White Salmon NFH	L. White Salmon	Little White Salmon River	4,272,833	
	1998-2001	Little White Salmon NFH	Urb-Mixed	Little White Salmon River	8,057,188	
Drano Lake		Abernathy NFH	Spring Creek	Drano Lake	40,756	
	1991	Spring Creek NFH	Urb-Bonn Dam	Spring Creek	14,348,604	
Spring Creek	1991	Spring Creek NFH	Clackamas	Spring Creek	3,292,304	
	1992-1996	Spring Creek NFH	Spring Creek	Spring Creek	89,083,822	
	1997-2001	Spring Creek NFH	Spring Creek	Spring Creek	70,435,986	
Big White Salmon River	1991-1996	Big White Salmon NFH	Carson	Big White Salmon River	3,581,536	
	1997-1999	Big White Salmon NFH	Carson	Big White Salmon River	2,795,464	
	2001	Big White Salmon NFH	Methow	Big White Salmon River	1,238,764	
	1997	Spring Creek NFH	Carson	Big White Salmon River	543,270	
Deep River	1999-2001	Deep River	Cowlitz	Deep River	255,657	
Abernathy Creek	1991-1996	Abernathy NFH	Abernathy Cr	Abernathy Creek	6,853,504	
	1997-1999	Abernathy NFH	Abernathy Cr	Abernathy Creek	1,223,647	
	1990-1994	Cowlitz	Cowlitz	Cowlitz River	9,016,451	
Cowlitz River	1992-1994	Friends Of Cow	Cowlitz	Cowlitz River	115,800	
	1995-2001	Cowlitz	Cowlitz	Cowlitz River	8,870,002	
	1995, 1997	Cowlitz	Cowlitz	Tilton River	3,074 Adults	
	1996, 1999	Friends Of Cowlitz	Cowlitz	Cowlitz River	53,800	
Toutle River	1991, 1993	Toutle	Cowlitz	Green River	641,382	
	1995	North Toutle	Toutle	Green River	1,412,100	
	1995	North Toutle	Washougal	Green River	1,086,100	
	1995-2001	North Toutle	Cowlitz	Green River	766,740	

Lewis River	1990-1993	Speelyai	Lewis	Lewis River	1,229,262
	1994	Lewis River	Kalama	North Fork Lewis River	975,700
	1991,1992	Lewis River	Lewis	Lewis River	1,885,900
	1990-1994	Lewis River	N F Lewis	North Fork Lewis River	1,801,800
	1996	Fish First Np	Lewis	Lewis River	55,872
	1997-2000	Fish First Np	Lewis	Lewis River	570,857
	1996,1998	Lewis River	Lewis	Lewis River	2,074,841
	2001	Lewis River	Lewis	Lewis River	34 Adults
	1995-2001	Lewis River	Lewis	Lewis River	4,692,781
	2001	Speelyai	Lewis	Lewis River	566,373
Kalama River	1990-1994	Lower Kalama	Kalama	Hatchery Creek	2,455,252
	1995-2001	Fallert Cr	Kalama	Fallert Creek	2,129,550
	1998,2000	Fallert Cr	Lewis	Fallert Creek	615,463
	1999	Gobar Pond	Kalama	Gobar Creek	87,500
	1997,2001	Kalama Falls	Kalama	Gobar Creek	332,281
	1993	Ringold	Carson	Spring Creek	68,900
	1993	Ringold	Kalama	Spring Creek	462,700
	1990	Ringold	Klickitat	Spring Creek	40,264
	1994	Ringold	L White Salmon	Spring Creek	336,268
	1993-1994	Ringold	Ringold	Spring Creek	596,274
Spring Creek	1992-1994	Ringold	Wind River	Spring Creek	2,250,000
	1991-1996	Carson NFH	Carson	Wind River	13,350,658
	1997-2001	Carson NFH	Carson	Wind River	7,096,346
	1991-1994	L White Salmon NFH	Spring Creek	Little White Salmon River	2,757,539
	1992	Willard NFH	Carson	Little White Salmon River	869,952
	1991-1994	L White Salmon NFH	Carson	Little White Salmon River	4,780,148
	1997	L White Salmon NFH	Carson	Little White Salmon River	2,835,741
	1998-2001	L White Salmon NFH	L White Salmon	Little White Salmon River	4,272,833
	1998-2001	L White Salmon NFH	Urb-Mixed	Little White Salmon River	8,057,188
		Abernathy NFH	Spring Creek	Drano Lake	40,756
Spring Creek	1991	Spring Creek NFH	Urb-Bonn Dam	Spring Creek	14,348,604
	1991	Spring Creek NFH	Clackamas	Spring Creek	3,292,304
	1992-1996	Spring Creek NFH	Spring Creek	Spring Creek	89,083,822
	1997-2001	Spring Creek NFH	Spring Creek	Spring Creek	70,435,986
Big White Salmon River	1991-1996	Big White Salmon NFH	Carson	Big White Salmon River	3,581,536
	1997-1999	Big White Salmon NFH	Carson	Big White Salmon River	2,795,464

	2001	Big White Salmon NFH	Methow	Big White Salmon River	1,238,764
	1997	Spring Creek NFH	Carson	Big White Salmon River	543,270

Lower Columbia River spring-run chinook salmon (Oregon)

Watershed	Years	Hatchery	Stock	Release Site	Total
Youngs Bay	1991-1992	Cedc	Clackamas	Youngs Bay	242,534
	1994	Cedc	North Santiam	Youngs Bay	301,361
	1992	Cedc	Willamette	Youngs Bay	301,786
	1996	Youngs Bay	Clackamas	Youngs Bay	97,945
	1995-1999	Youngs Bay	Willamette	Youngs Bay	3,114,060
	1996	Youngs Bay	South Santiam	Youngs Bay	276,493
Lower Columbia River	1996	Blind Slough	South Santiam	Blind Slough	199,389
	1995-2002	Blind Slough	Willamette	Blind Slough	1,457,655
	1996	Tongue Pt	South Santiam	Tongue Point	242,319
	1997-2000	Tongue Pt	Willamette	Tongue Point	1,029,850
	1991	Cedc	Clackamas	South Fork Klaskanine River	119,627
	1994	Cedc	North Santiam	South Fork Klaskanine River	109,974
Multnomah Channel	1992, 1997	Cedc	Willamette	South Fork Klaskanine River	238,316
	1996	Cedc	South Santiam	South Fork Klaskanine River	76,618
	1997-1998	Step	McKenzie	Little Willamette River	123,134
	1991-1994	Clackamas	Clackamas	Sandy River	1,316,973
	1991-1993	Clackamas	Clackamas	Salmon River	594,656
	1995-2002	Clackamas	Clackamas	Sandy River	3,539,458
Sandy River	1991-1992	Bonneville	Lookingglass	Hood River	288,727
	1993-1995	Bonneville	Deschutes	Hood River	245,209
	1996-2001	Various (3)	Deschutes	Hood River	677,652
	2000-2002	Parkdale	Wild Origin	Hood River	101,883
	2000	Parkdale	Hood River	Hood River	4,126

Lower Columbia River up-river bright chinook salmon (Washington)

Watershed	Years	Hatchery	Stock	Release Site	Total
Little White Salmon River	1991-1993	L. White Salmon NFH	Urb-Eggbank	Little White Salmon River	8,758,842
	1994-1996	L. White Salmon NFH	Carson	Little White Salmon River	8,453,502
	1994-1996	L. White Salmon NFH	Carson	Little White Salmon River	1,225 Adults

Spring Creek	1994	Ringold	Urb-Bonn Dam	Spring Creek	4,217,491
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Note: "up-river bright" chinook salmon are not in the Lower Columbia River chinook salmon ESU.